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FINAL REPORT

USEPA METHOD STUDY 7

ANALYSES FOR TRACE ELEMENTS IN WATER BY ATOMIC ABSORPTION SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

by

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16. ABSTRACT

This report describes a study of ten elements: aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, selenium and zinc, at trace levels in water. Six sample concentrates, each containing the ten trace elements, were sealed in glass ampuls, verified as homogeneous and stable over time, and provided to the analysts with instructions for sample preparation and analyses. The analysts were instructed to add an aliquot of each concentrate to a volume of distilled water and to a volume of natural water and to perform AA or colorimetric analyses for the ten elements. Results from distilled water evaluated the proficiency of the method free of interferences while by-difference results from natural waters, analyzed with and without the increment, may reveal interferences with the method from a particular sample matrix. Samples were prepared in three pairs, in which the concentrations of analytes were slightly different for each sample of a pair. One pair contained the trace elements near minimum detectable levels, a second contained intermediate levels and the last contained higher levels, but all within the linear response ranges of the calibration curves. The analysts performed single analyses on each sample for each analyte as in routine analyses. Mean recovery, overall standard deviation and single-analyst standard deviations were calculated for each element at each concentration and for the two water types. Regression equations for recovery and precision were generated, and practical effects of water type noted.

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FOREWORD

Environmental measurements are required to determine the quality of drinking waters, ambient waters and the character of waste effluents. The Environmental Monitoring and Support Laboratory - Cincinnati (EMSL-Cincinnati), conducts research to:

- Develop and evaluate techniques to measure the presence and concentration of physical, chemical, and radiological pollutants in water, wastewater, bottom sediments, and solid waste.
- Investigate methods for the concentration, recovery, and identification of viruses, bacteria, and other microorganisms in water.
- Determine the response of aquatic organisms to water quality.
- Support an Agency-wide quality assurance program to assure standardization and quality control of systems for monitoring water and wastewater.

This publication of EMSL-Cincinnati, entitled: USEPA Method Study 7, Method 200.0, Trace Metals by Atomic Absorption (AA) Spectroscopy (Direct Aspiration) and Colorimetry, reports the results of USEPA's interlaboratory method study for analyses in waters and wastewaters of the following ten trace elements: aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, selenium, and zinc.

Federal agencies, states, municipalities, universities, private laboratories, and industry should find this study of value in monitoring and controlling water pollution in the environment.

Robert L. Booth
Director, EMSL-Cincinnati

ABSTRACT

This report describes a study of USEPA Method 200.0, Atomic Absorption (AA) Spectroscopy (direct aspiration), and Colorimetry, for ten elements: aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, selenium and zinc, at trace levels in water.

The study design was based on Youden's original non-replicate plan (1) for collaborative evaluation of analytical methods.

Six sample concentrates, each containing the ten trace elements, were sealed in glass ampuls, verified as homogeneous and stable over time, and provided to the analysts with instructions for sample preparation and analyses. The analysts were instructed to add an aliquot of each concentrate to a volume of distilled water and to a volume of natural water (river, lake, estuary, tap, wastewater, etc.), and to perform AA or colorimetric analyses for the ten elements. Results from distilled water evaluated the proficiency of the method free of interferences while by-difference results from natural waters, analyzed with and without the increment, reveal interferences with the method from a particular sample matrix, if present. Samples were prepared in pairs, in which the concentrations of analytes were slightly different for each sample of a pair. Three pairs of samples were used: one contained the trace elements near minimum detectable levels, a second contained intermediate levels and the last contained higher levels, but all to be within the linear response ranges of the calibration curves. The analysts performed single analyses on each sample for each analyte as in routine analyses. Analysts were cautioned that the lowest levels of analyte in the study might require concentration or extraction before measurement.

The data from the study which was conducted in 1972, were originally evaluated with the computerized collaborative study program (COLST) and used to produce precision and bias statements for the 1979 edition of USEPA's manual of water methods (2). These same data were re-evaluated for this report utilizing the current (FY86) EMSL-Cincinnati statistical program, Interlaboratory Method Validation Study (IMVS), to make the results comparable to similar studies involving the same metals by AA-Furnace and Inductively Coupled Plasma (ICP), also evaluated by IMVS. Mean recovery, overall standard deviation and single-analyst standard deviations were calculated for each element at each concentration and for the two water types. Regression equations for recovery and precision were generated, and practical effects of water type noted.

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INTRODUCTION

The study was designed to evaluate the AA flame spectroscopy and colorimetry methods of analyses recommended for those metals most common in industrial discharges or most often cited in NPDES permits as contaminants: Aluminum (Al), Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Lead (Pb), Manganese (Mn), Selenium (Se), and Zinc (Zn). Since wastewater discharges to streams and lakes ultimately become public water supplies to other communities, most of these elements are of interest for analysis of drinking water supplies as well.

It is important that USEPA laboratories and water-oriented laboratories of other federal and state agencies and the private sector use methods of analyses which have been evaluated statistically for precision, bias, and general interferences under the controlled conditions of an interlaboratory study.

The participant laboratories should be representative of laboratories monitoring discharges, that is, permittees, consultant laboratories and the state and federal regulatory agencies. Consequently, regulatory needs established the elements, their concentrations, the methods of analyses and the laboratories who participated in this study.

Statistical parameters from the study were originally estimated using a computer program (COLST) developed in the mid-1970's. These statistics were published as the precision and bias statements in the current manual of USEPA methods (2). Several years ago, however, the statistical estimation procedure for method studies was modified to be compatible with the ASTM Standard D2777-77 (3). To make results of this study comparable to the recent studies conducted for the AA-furnace and ICP methods, it was necessary to re-evaluate the study data using the current computerized evaluation program, IMVS, to prepare this report. When the USEPA methods manual is updated, results from this re-evaluation will be used as the basis for relevant precision and bias statements.

SUMMARY

The Quality Assurance Branch (QAB) of the Environmental Monitoring and Support Laboratory - Cincinnati (EMSL-Cincinnati) conducted an interlaboratory study on the USEPA methods of analysis for aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, selenium and zinc in water.

The methods evaluated in this study which are described in the 1971 edition of USEPA's methods (4) and included in Appendix A of this report, are direct aspiration atomic absorption (AA) techniques, except for arsenic and selenium analyses which are silver diethyl-dithiocarbamate and diaminobenzidine colorimetric procedures, respectively.

Three sample concentrates were prepared as pairs with slightly different concentrations for each of the elements, with the intention of representing the full range of linear response. An aliquot of each concentrate was added to distilled water and natural water samples by the analysts. One measurement was made on the natural water as background and one measurement was made on each of the distilled water and natural water samples with the added increments. Recoveries from the natural water samples were calculated by difference. Statistical estimates such as mean recovery, standard deviation, bias, etc., were calculated from the results with each water sample and increment level. A review of revised detection limits in the current USEPA manual for the eight AA analytes by direct aspiration, shows that the lowest concentrations studied were too low for dependable results by AA, direct aspiration. Therefore, the regressions for AA methods, shown in Table 1, were developed from the estimates at the medium and high concentration levels. The regressions for colorimetric analyses of arsenic and selenium used all three concentration levels. The regression equations estimate the mean recovery ($\overline{X}$), overall standard deviation (S) and single-analyst standard deviation (S_r) which may be expected in routine work within the concentration (C) range indicated.

USEPA METHOD STUDY 7, TRACE METALS BY AA/COLORIMETRY

TABLE 1: SUMMARY OF STATISTICAL REGRESSIONS

Analyte	Conc. Range of Studied Data Used, ug/L	Recovery from Distilled Water By Direct Aspiration	Recovery from Natural Water of Choice By Direct Aspiration
Aluminum	500 to 1205	$\bar{X} = 0.979(C) + 6.16$	$\bar{X} = 1.080(C) - 57.6$
		$S = 0.066(\bar{X}) + 125$	$S = 0.115(\bar{X}) + 108$
		$S_r = 0.086(\bar{X}) + 40.5$	$S_r = 0.081(\bar{X}) + 57.0$
Arsenic*	20 to 292	$\bar{X} = 0.850(C) - 0.25$	$\bar{X} = 0.854(C) + 2.03$
		$S = 0.198(\bar{X}) + 5.93$	$S = 0.240(\bar{X}) + 3.54$
		$S_r = 0.122(\bar{X}) + 3.10$	$S_r = 0.151(\bar{X}) + 0.97$
Cadmium	14 to 78	$\bar{X} = 0.919(C) + 2.97$	$\bar{X} = 0.923(C) + 3.15$
		$S = 0.108(\bar{X}) + 5.08$	$S = 0.063(\bar{X}) + 5.10$
		$S_r = 0.120(\bar{X}) + 0.89$	$S_r = 0.054(\bar{X}) + 1.63$
Chromium	74 to 407	$\bar{X} = 0.976(C) + 3.94$	$\bar{X} = 0.977(C) + 1.21$
		$S = 0.131(\bar{X}) + 4.26$	$S = 0.116(\bar{X}) + 10.1$
		$S_r = 0.052(\bar{X}) + 3.01$	$S_r = 0.036(\bar{X}) + 7.81$
Copper	60 to 332	$\bar{X} = 0.963(C) + 3.49$	$\bar{X} = 0.936(C) + 1.83$
		$S = 0.047(\bar{X}) + 12.3$	$S = 0.086(\bar{X}) + 8.18$
		$S_r = 0.042(\bar{X}) + 4.60$	$S_r = 0.022(\bar{X}) + 5.33$
Iron	350 to 840	$\bar{X} = 0.999(C) - 2.21$	$\bar{X} = 0.956(C) + 42.1$
		$S = 0.022(\bar{X}) + 41.0$	$S = -0.016(\bar{X}) + 93.8$
		$S_r = 0.019(\bar{X}) + 21.2$	$S_r = -0.011(\bar{X}) + 64.2$
Lead	84 to 367	$\bar{X} = 0.961(C) + 13.8$	$\bar{X} = 0.993(C) + 12.2$
		$S = 0.028(\bar{X}) + 33.9$	$S = 0.151(\bar{X}) + 17.3$
		$S_r = 0.011(\bar{X}) + 16.1$	$S_r = 0.117(\bar{X}) + 5.92$
Manganese	84 to 469	$\bar{X} = 0.987(C) - 1.27$	$\bar{X} = 0.982(C) + 4.15$
		$S = 0.042(\bar{X}) + 8.95$	$S = 0.051(\bar{X}) + 10.4$
		$S_r = 0.023(\bar{X}) + 4.90$	$S_r = 0.026(\bar{X}) + 3.59$
Selenium*	4.7 to 49	$\bar{X} = 0.643(C) + 1.23$	$\bar{X} = 0.584(C) + 1.15$
		$S = 0.431(\bar{X}) - 0.69$	$S = 0.613(\bar{X}) - 1.13$
		$S_r = 0.192(\bar{X}) - 0.18$	$S_r = 0.330(\bar{X}) + 0.53$
Zinc	56 to 310	$\bar{X} = 0.999(C) + 0.33$	$\bar{X} = 0.991(C) + 1.51$
		$S = 0.078(\bar{X}) + 10.8$	$S = 0.067(\bar{X}) + 12.3$
		$S_r = 0.049(\bar{X}) + 1.10$	$S_r = 0.035(\bar{X}) + 4.76$

*Colorimetric analyses.

DESCRIPTION OF STUDY

Sample pairs containing three different levels of the elements: aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, selenium and zinc, were prepared as concentrates in sealed glass ampuls and presented to each analyst with complete instructions. The analysts were required to add an aliquot of each concentrate to a volume of reagent water and to a volume of natural water (river, lake, estuary, tap, wastewater, etc.). Analysis in reagent water will show the proficiency of the method on water samples free of interferences while analysis in a natural water may reveal sample matrix interferences in the method. Three pairs of samples were used: one was intended to contain the elements near the detection limits, a second contained intermediate levels and the last contained higher levels. Analysts were cautioned that the lowest concentrations in the study might require concentration or extraction before measurement.

Preparation of Samples

Sample concentrates were prepared by dissolving precisely-weighed amounts of reagent-grade chemicals in high-purity water to produce accurate concentrations of aluminum, arsenic, cadmium, copper, chromium, iron, lead, manganese, selenium and zinc.

Six concentrates were prepared from stock solutions containing weighed amounts of certified reagent-grade* elemental, oxide or salt forms in an acidified reagent water.** Concentrated redistilled nitric acid, hydrochloric acid, and heat were used to solubilize the trace elements.

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*All chemicals except chromium were certified pure from Johnson-Mathey. The chromium as chromium trioxide, was a reagent-grade chemical.

**Prepared by passage of distilled water through a four-cartridge Millipore Super-Q system (Millipore Corp.).

The chemical forms used are given in Table 2:

TABLE 2: CHEMICALS USED TO MAKE STUDY SAMPLES

Analyte	Form
Al	Aluminum Metal
As	Arsenic Trioxide
Cd	Cadmium Oxide
Cr	Chromium Trioxide
Cu	Copper Powder
Fe	Iron Sponge
Pb	Lead Nitrate
Mn	Manganese Metal
Se	Selenium Powder
Zn	Zinc Oxide

EMSL-Cincinnati analyzed the samples repeatedly over a period of four months to verify their true values, homogeneity and stability over time. Further confirmation of the true values was attained through analyses by two independent referee laboratories. The levels of metals studied ranged from minimum detectable levels by the methods studied, to levels present in polluted waters.

When diluted to volume with distilled water according to the instructions, the samples contained the concentrations shown in Table 3.

TABLE 3: TRUE CONCENTRATIONS FOR DISTILLED WATER SAMPLES in ug/liter

Element	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Al	1205	500	625	1004	35	15
As	292	80	67	266	29	20
Cd	71	14	18	78	1.4	2.8
Cr	370	74	93	407	7.4	15
Cu	302	60	75	332	7.5	12
Fe	840	350	438	700	24	10
Pb	367	101	84	334	37	25
Mn	426	84	106	469	11	17
Se	43	12	19	49	4.7	7.8
Zn	281	56	70	310	7.0	11

The methods of analyses evaluated were those from the 1971 edition of the USEPA Methods Manual (4). Copies of these methods and instructions for preparation of samples, analyses and reporting results (See Appendix A for details) were sent with the samples. Analyses were by atomic absorption techniques, except for arsenic and selenium which were determined by the silver diethyldithio- carbamate and diaminobenzidine colorimetric procedures, respectively. Analysts were asked to do only those analyses performed regularly in their laboratory. Since all samples contained dissolved pure trace elements, digestion was not necessary.

Analysts were instructed that the levels in some samples might be below the level of detection by direct aspiration AA and that some concentration technique might be necessary. Sample concentration by evaporation, chelation/extraction, sample boat or ribbon technique were permitted. Further, if concentration was used, analysts were instructed to precede analysis with an oxidation step.

TEST DESIGN

The test design upon which this interlaboratory study was based is similar to the approach recommended by Youden (1). In this non-replicate approach to determining the precision and bias of an analytical method, pairs of samples of similar, but different concentrations are analyzed. The pair of samples is referred to as a Youden pair. The key idea in the Youden approach is to estimate single-analyst precision from analyses of Youden pairs rather than through the use of replicate analyses. By avoiding known replicate analyses, the Youden approach hopes to prevent the analysts' well-intentioned modifications of initial analytical results when known replicates disagree.

Analysis and Reporting

The study was conducted as follows:

1. Six samples were prepared as concentrates in sealed, glass ampuls and shipped to the analyst as unknowns.

2. When the analyst was ready to begin, each ampul was opened, a specific volume (5.0 or 10.0 mL) of the concentrate withdrawn and diluted to one liter with distilled water.

3. Following the same directions, a separate aliquot of each sample concentrate was also diluted to one liter in a natural water or wastewater of choice.

4. To ensure solubility and stability of each sample, the analyst was instructed to add reagent grade nitric acid during sample preparation to bring the concentration to 0.15 percent.

5. Analyses were performed for ten (10) trace elements.

Accurate measurement of a trace element in distilled water confirms the analyst's ability to measure the element in a sample free of interferences. Recovery of the trace element increment from natural water will indicate the absence, presence and magnitude of interferences. However, please realize that variable interference among the natural waters will not allow meaningful estimates of the magnitude of interferences and/or the results of infrequent interference may be rejected as an outlier.

Distribution of Samples

An invitational memorandum announced the study to each USEPA Region in August, 1972. The study was also announced in USEPA's Analytical Quality Control Newsletter circulated to about 7,000 technical offices and laboratories of government and private agencies in the United States and Canada.

One hundred and sixteen laboratories from USEPA, other federal, state and local agencies, universities and private industry in the United States and Canada responded. After a pre-set, cut-off date, samples were packed and shipped. Since the colorimetric analysis for selenium required one liter of sample, two sets of ampuls were sent to those who indicated they would do selenium analyses.

Each collaborator was sent a set(s) of six ampuls containing sample concentrates, instructions for sample preparation, copies of the analytical procedures to be used, and duplicate report sheets. Participants were allowed thirty days to complete the analyses and report the data. All data returned were included in this report.

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Florida Dept. of Air and Water
Pollution Control
Winter Haven, FL 33881

FMC Corporation
Pocatello, ID 83201

Froehling & Robertson, Inc.
Richmond, VA 23261

General Testing Labs, Inc.
Kansas City, MO 64108

Georgia Dept. of Natural Resources
Atlanta, GA 30334

Government of Alberta
Pollution Control Laboratory
Edmonton, Alberta, Canada

Gulf Research & Development Company
Pittsburgh, PA 15230

Harris Laboratories
Lincoln, NE 68501

PARTICIPATING NON-USEPA LABORATORIES

(Continued)

Method Study 7, Trace Metals

Illinois Environ. Protection Agency
Champaign, IL 61820

Indiana Div. of Water Quality
Muncie, IN 47304

Indiana State Board of Health
Indianapolis, IN 46206

Industrial Testing Labs
St. Louis, MO 63104

Interstate Sanitation Commission
New York, NY 10019

Kansas City Water Pollution
Control Dept.
Kansas City, KS 66118

Kem-Tech Laboratories
Baton Rouge, LA 70808

Kentucky Water Pollution Control
Commission
Frankfort, KY 40601

Koppers Company, Inc.
Monroeville, PA 15146

Langston Laboratories
Leawood, KA 66209

Los Angeles Dept. of Water & Power
Los Angeles, CA 90051

Maryland Dept. of Health
Baltimore, MD 21218

Metropolitan Denver Sewage
Disposal District
Commerce City, CO 80022

Metropolitan Sanitary District
of Greater Chicago
Cicero, IL 60650

Michigan Dept. of Natural Resources
Lansing, MI 48926

Midwest Research Institute
Kansas City, MO 66110

Montana Bureau of Mines & Geology
Butte, MT 59701

New Mexico Bureau of Mines
Socorro, NM 87801

North Carolina Dept. of Natural
& Economic Resources
Raleigh, NC 27611

North Dakota Health Dept.
Bismarck, ND 58501

Northern Arizona University
Flagstaff, AZ 86001

NUS Corporation
Pittsburgh, PA 15205

Oilwell Research, Inc.
Long Beach, CA 90813

Oklahoma Dept. of Health
Oklahoma City, OK 73105

Ouachita University
Arkadelphia, AR 71923

Pennsylvania Dept. of Environ.
Resources
Harrisburg, PA 17120

PARTICIPATING NON-USEPA LABORATORIES
(Continued)

Method Study 7, Trace Metals

Pennsylvania Dept. of Transportation
Harrisburg, PA 17120

Philadelphia Water Dept.
Philadelphia, PA 19137

Ralston Purina Company
St. Louis, MO 63188

Rockford Sanitary District
Rockford, IL 61105

Roy F. Weston
West Chester, PA 19380

St. Louis County Water Company
University City, MO 63124

St. Louis Dept. of Public Utilities
St. Louis, MO 63110

St. Louis Testing Laboratory
St. Louis, MO 63103

Seattle Metro Water Quality Lab
Seattle, WA 98119

Serco Laboratories
Minneapolis, MN 55406

Shilston Testing Laboratory
New Orleans, LA 70112

South Dakota School of Mines
and Geology
Rapid City, SD 57701

Southern Testing & Research
Labs, Inc.
Wilson, NC 27893

Stewart Laboratories
Knoxville, AL 37921

Technical Micronics Control, Inc.
Madison, AL 35758

Tenco Hydro/Aerosciences
Countryside, IL 60525

Tennessee Valley Authority
Chattanooga, TN 37401

Texas Dept. of Health
Austin, TX 78756

Toms River Chemical Corp.
Toms River, NJ 08753

TRC-The Research Corp. of New England
Hartford, CT 06106

University of Idaho
Moscow, ID 83843

University of Kansas
Lawrence, KS 66044

University of Missouri
Columbia, MO 65201

U.S. Air Force
Environ. Health Laboratory
Kelly AFB, TX 78241

U.S. Dept. of the Army
Corps of Engineers
Cincinnati, OH 45201

U.S. Dept. of the Army
Edgewood Arsenal, MD 21010

PARTICIPATING NON-USEPA LABORATORIES

(Continued)

Method Study 7, Trace Metals

U.S. Geological Survey
Charlottesville, VA 22903

U.S. Geological Survey
Harrisburg, PA 17108

U.S. Naval Facilities Engrg. Command
Pearl Harbor Division
FPO San Francisco, CA 96610

U.S. Naval Facilities Engrg. Command
Environ. Engrg Lab
San Diego, CA 92132

U.S. Pipe & Foundry Company
Birmingham, AL 35202

Utah Environmental Lab
Port Hardy, B.C., Canada

Utah Division of Health
Salt Lake City, UT 84113

Ute Research Laboratory
Fort Duchesne, UT 84026

Vermont Dept. of Water Resources
Montpelier, VT 05602

Washington Dept. of Ecology
Olympia, WA 98504

Washington State University
Pullman, WA 99163

Wastex Laboratories
Pottstown, PA 19464

West Coast Technical Service, Inc.
San Gabriel, GA 91776

West Virginia Dept. of Health
Charleston, WV 25305

West Virginia Dept. of Natural Resources
Elkins, WV 26241

West Virginia Dept. of Water Resources
Charleston, WV 25305

Westinghouse Electric Corp.
Madison, PA 15663

Westinghouse (NFD)
Columbia, SC 29205

Wheeling-Pittsburgh Steel Corp.
Benwood, WV 26031

Wilson & Company
Salina, KS 67401

Wyoming Dept. of Agriculture
Laramie, WY 82070

RESULTS

Appendix B presents Tables 4 through 23 which contain all raw data received, identified only by laboratory and analyst codes. Footnotes on analytical techniques other than direct analysis follow the response to which they relate.

Need to Limit Data Sets to 50 or Fewer Responses

The original AA study design utilized a very large number of laboratories (17 USEPA and 99 other federal, state, local agency, private and industrial laboratories). However, the present IMVS computer program limits to 50, the number of data sets it can treat statistically. Since the IMVS program is extremely complex and too difficult to modify in a limited time, it was necessary in these instances, to reduce data sets for a metal to 50 responses to accommodate use of the IMVS program. Where necessary, this data reduction was made as unbiased as possible by applying the following rules:

To minimize the amount of usable data lost in the reduction, responses that were not "complete" were deleted first. A "complete response" was defined as usable distilled and natural water data for the four samples representing the high and medium concentration levels. As used here, "usable" means direct AA analysis by the 200.0 method and a determinate quantitative result, i.e., not a zero, less than or blank. Because of the problems of variable detection limit for each laboratory and sample combination, there were no requirements that data for the two low concentration samples be usable.

1. For each data set to be statistically treated, no data were removed if there were $\leq$ 50 laboratories contributing data.

2. If the total was over 50, but complete responses were $\leq$ 50, incomplete responses were randomly deleted until 50 remained.

3. If there were more than 50 complete responses, all incomplete responses were deleted and complete responses were randomly deleted until 50 remained.

Data Segregation by Method of Analyses

Since four combinations of "concentration" and analyses were permitted for aluminum, cadmium, chromium, copper, iron, manganese, lead and zinc in this study, data for these low-level samples were segregated by techniques prior to data treatment:

1. Concentration by evaporation.
2. Chelation extraction.
3. Sample boat or ribbon.
4. Direct aspiration.

The concentration techniques reported in this study are still approved, but are not as efficient as the current techniques used to improve results at low concentrations.

Arsenic and selenium were analyzable by silver diethyldithiocarbamate and diaminobenzidine colorimetric methods, respectively.

In the tables of all data received (Tables 4 through 23 in Appendix B), data were reported as direct aspiration data, except where footnoted. The different concentration techniques are footnoted as follows:

"CT" means concentration by evaporation.
"EX" means chelation extraction.
"SB" means sampling boat or ribbon.

The colorimetric data were evaluated statistically at all concentrations. For the eight AA metals, data for the first four samples, the medium and high concentrations studied, were evaluated together, but all direct aspiration, extraction and concentration data for the low concentration samples, 5 and 6, were evaluated separately. The sample boat/ribbon data were too limited and were not evaluated statistically.

TREATMENT OF DATA

The objective of this interlaboratory study was to determine the accuracy and precision of Method 200.0 "Atomic Absorption Spectrometric Method for Trace Element Analysis of Water and Wastes" through the use of statistical analysis techniques designed to extract and summarize the relevant information. The techniques are similar to those suggested in the American Society for Testing and Materials (ASTM) Standard Practice D2777-77 (3).

The algorithms required to perform the statistical analyses have been integrated into a USEPA system of computer programs referred to as IMVS. The analyses performed by IMVS (5) include several tests for the rejection of outliers (laboratories and individual data points), summary statistics by concentration level for mean recovery (accuracy), overall and single-analyst standard deviation (precision), determination of the linear relationship between mean recovery and concentration level, determination of the linear relationship between the precision statistics and mean recovery, and a test for the combined effect of natural waters on recovery and precision. A detailed description of the statistical analysis procedures applied separately to each data set to be evaluated by element, water and analytical procedure, is presented below.

REJECTION OF OUTLIERS

Spurious data points are always a part of any set of data collected during an interlaboratory test program. It is important to identify and remove these data points because they can lead to values of summary statistics which are not representative of the general behavior of the method. However, some erratic behavior in the data may be directly related to some facet of the method under study. Therefore, spurious data points should not be removed indiscriminately, and any points that are removed should be clearly identified since further investigation of the analytical conditions related to the outliers might be of value. Data rejected as outliers for this study as a result of the following tests for outliers have been identified by the symbol "*" in the tables of evaluated data in Appendix C.

Youden's Laboratory Ranking Procedure for Outliers

In some cases the analytical values reported by a specific laboratory are so consistently high or low that a large systematic error may be attributed to that laboratory. These data are not representative of the method and should be rejected. Youden's (1) ranking test for outlying laboratories was applied at the 5 percent level of significance.

The Youden laboratory ranking procedure requires a complete set of data from every laboratory within a given water type. Missing data from laboratory i for water type j are replaced by the following procedure. Letting X_{ijk} denote the reported measurement from laboratory i for water type j and concentration level C_k, it is assumed that:

$$X_{ijk} = \beta_j \cdot C_k^{\gamma_j} \cdot L_i \cdot \varepsilon_{ijk} \qquad (1)$$

where β_j and γ_j are fixed parameters which determine the effect of water type j, L_i is the systematic error due to laboratory i and ε_{ijk} is the random within laboratory error. Taking natural logarithms, it follows that:

$$\ell n\, X_{ijk} = \ell n\, \beta_j + \gamma_j\, \ell n\, C_k + \ell n\, L_i + \ell n\, \varepsilon_{ijk} \qquad (2)$$

which is a linear regression model with dependent variable $\ell n\, X_{ijk}$ and independent variable $\ell n\, C_k$. Details and justification for this model are discussed in the section "Comparison of Accuracy and Precision Across Water Types."

The natural logarithms of the individual laboratory's data were regressed against the natural logarithms of the true concentration levels for the six ampuls in each water type. The predicted values $\ell n\, X_{ijk}$ were obtained from the regression equation, and the missing values for X_{ijk} were estimated by $X_{ijk} = \exp\, (\ell n\, X_{ijk})$, where exp(X) denotes the constant e raised to the power X.

If the ranking test rejected a laboratory for a specific water type, then all of the laboratory's data for that water type were rejected as outliers. The rejected values were excluded from all the remaining analyses. In addition, after completion of the laboratory ranking, the predicted values created to fill in for the missing data were rejected and excluded from further analyses for all laboratories.

Tests for Individual Outliers

After the laboratory ranking procedure, all missing, "less than" and zero, values among the remaining data were also rejected. Next, the test for individual outliers constructed by Thompson (6) and suggested in the ASTM Standard Practice D2777-77 (3) was applied separately to the data from each sample using a 5 percent significance level. If an individual data point was rejected based on this test, it was rejected from further consideration and the test was repeated using the remaining data for that sample. This process was continued for each sample until no additional data could be rejected. Tables 24 through 51 show (in Appendix C) the data actually evaluated under each set of conditions, with all rejected values marked with an asterisk (*).

STATISTICAL DATA SUMMARIES

Several summary statistics were calculated using the data remaining after the outlier rejection tests were performed. These summary statistics include: the number of retained data points, the mean recovery, bias as a percent relative error, the absolute overall standard deviation, the percent relative overall standard deviation, the absolute single-analyst standard deviation, and the percent relative single-analyst standard deviation. The basic formulas used to calculate these statistics are presented below where $X_1, X_2, \ldots, X_n$ denote the values of the n retained data points for one set of the analytical conditions and a specific sample.

Mean Recovery ($\bar{X}$):

$$\bar{X} = \frac{1}{n} \sum_{i=1}^{n} X_i$$

Bias as a Percent Relative Error:

$$\text{Percent RE} = \frac{\bar{X} - \text{True Value}}{\text{True Value}} \quad (100)$$

Overall Standard Deviation:

$$S = \sqrt{\frac{1}{n - 1} \sum_{i=1}^{n} (X_i - \bar{X})^2}$$

and

Percent Overall Relative Standard Deviation:

$$\text{Percent RSD} = \frac{100(S)}{\bar{X}}$$

The overall standard deviation, S, indicates the precision associated with measurements generated by a group of laboratories. This represents the broad variation in the data collected in an interlaboratory study. However, a measure of how well an individual analyst can expect to perform in his own laboratory is another important measure of precision.

This Single-analyst Standard Deviation can be estimated for each Youden pair by:

$$S_r = \sqrt{\frac{1}{2(m - 1)} \sum_{i=1}^{m} (D_i - \bar{D})^2}$$

Where

m = The number of complete sets of Youden pair observations remaining after outliers have been removed,

D_i = The difference between the observations in Youden pair i,

and

$\bar{D}$ = Average of the Di values.

The Percent Relative Single-analyst Standard Deviation:

$$\text{Percent RSD-}S_r = \frac{100(S_r)}{\bar{X}^*}$$

where $\bar{X}^*$ is the average of the two mean recovery statistics corresponding to the two samples for which the S_r was estimated.

The summary statistics in Tables 52, 54, 55, 57, 59, 61, 63, 65, 67 and 68 (see Appendix D) provide detailed information on the recovery and precision of the data obtained by analyses without concentration or extraction at each concentration level, the most basic objective of the study. For the eight AA analytes, please note that the direct aspiration data from samples 5 and 6, the Youden pair with the lowest concentrations, were statistically analyzed separately from data for the other samples so that statistics at the medium and high levels studied would not be influenced by the way the low-level analyses were conducted, i.e., whether these were performed using direct aspiration, extraction or concentration.

Tables 53, 56, 58, 60, 62, 64, 66 and 69 in Appendix D provide the statistical results obtained from the data reported for the low concentration sample pair of the eight AA analytes. Statistics from the direct aspiration data reported for these samples are repeated here to simplify comparison with the separate statistics generated from data produced after extraction or concentration of the samples before analysis.

A systematic relationship often exists between the mean recovery and the true concentration level of the analyte in a sample. In addition there are often systematic relationships between the precision statistics and the mean recovery. Frequently, these systematic relationships can be adequately approximated by a linear relationship (i.e., by a straight line). Once these straight lines are established, they can be used to conveniently summarize the behavior of the method within a water type, and they can aid in comparing the behavior of the method across water types. In addition, they can be used to obtain estimates of the accuracy and precision at any concentration level within the applicable range studied. They can also be used to predict the behavior of the method when used under similar conditions. These important relationships are discussed below.

The statistical estimates for direct-aspiration of the low-concentration pair of samples did not relate well to direct-aspiration statistics at the higher concentrations for most of the eight AA analytes. In retrospect, the low pair for these analytes was designed at too low a concentration for direct aspiration without prior concentration or extraction. Table 70 shows how the concentrations of the lowest-level sample pair relate to the detection limits for direct aspiration published in the 1971 and 1979 editions of the USEPA methods (2, 4). Since the lowest study concentrations for six of the AA analytes are below one or both of these official detection limits, it is quite reasonable to question the validity of the direct aspiration data reported for these analytes. Although the lowest concentrations for zinc are slightly above both detection limits, the percent recovery and relative standard deviation statistics in Table 68 suggest these concentrations were also too low for direct aspiration. Regarding the remaining AA analyte, manganese, neither the detection limits in Table 70 nor the study statistics in Table 65 justify ignoring the lowest concentration results for direct aspiration. However, in the interest of consistent treatment for all eight AA analytes and the knowledge that consideration of the low-concentration results for manganese would not materially change Table 1, all recovery and precision regressions were fitted using the results for direct aspiration of the medium and high-concentration sample pairs.

TABLE 70: Relationship Among Stated Method Detection Limits and the Lowest Study Concentrations

Analyte	Detection Limit (4) ug/L	Detection Limit (2) ug/L	Lowest Levels Studied, ug/L
Aluminum	100	100	15, 35
Arsenic	10	2	20, 29
Cadmium	1	5	1.4, 2.8
Chromium	10	50	7.4, 15
Copper	5	20	7.5, 12
Iron	4	30	10, 24
Lead	10	100	25, 37
Manganese	5	10	11, 17
Selenium	3	2	4.7, 7.8
Zinc	5	5	7, 11

Besides lines representing the regressions from Table 1, Figures 1 through 20 contain points for the relevant information from Tables 52 through 69 in Appendix D. For example, the two plots in Figure 5 each contain the four direct aspiration points for the true cadmium concentrations in the 14 to 78 ug/L range from which the regression for direct aspiration recovery were developed. In addition, points representing the recoveries of direct aspiration, extraction and concentration on the low-concentration samples are shown to allow visual comparison among these recoveries and with the extension of the regression line to the same low concentrations. The regressions for arsenic and selenium were developed using statistics from all six samples.

STATEMENT OF METHOD RECOVERY

The recovery of the method is characterized by the relationship of the mean recovery ($\overline{X}$) to the true concentration (C) of the analyte in a water sample. In order to obtain a mathematical expression for this relationship, a regression line of the form

$$\overline{X} = a + b\ (C) \qquad (3)$$

is often fitted directly to the data using a regression technique called the "least-squares algorithm".

However, when the true concentration values vary over a wide range, the mean recovery statistics associated with the larger concentration values tend to dominate the fitted regression line, producing relatively larger errors in the estimates of mean recovery at the lower concentration values. In order to eliminate this problem, a weighted approach was used to fit the mean recovery data to the true concentration values. The weighted approach involved dividing both sides of Equation (3) by C resulting in Equation (4)

$$\frac{\overline{X}}{C} = a\left(\frac{1}{C}\right) + b \qquad (4)$$

The ($\overline{X}$/C) values were regressed against the (1/C) values using ordinary least-squares algorithm to obtain estimates for the values a and b. (This is equivalent to performing a weighted least-squares with weights $w = 1/c^2$; see

Reference (7), page 108 for details.) Equation (4) can easily be converted to the desired relationship given by Equation (3) by simply multiplying both sides of Equation (4) by C. The intercept (b) from Equation (4) becomes the slope (b) for Equation (3) and the slope (a) from Equation (4) becomes the intercept (a) for Equation (3). Equation (3) can be used to estimate recovery over the range of concentration used in the study.

STATEMENT OF METHOD PRECISION

The precision of the method may be characterized by the relationships between precision statistics (S and S_r) and mean recovery ($\overline{X}$). In order to obtain a mathematical expression for these relationships, regression lines of the form

$$S = d + e\,(\overline{X}) \tag{5}$$

and

$$S_r = f + g\,(\overline{X}^*) \tag{6}$$

are desired.

As discussed previously with respect to recovery, the values of $\overline{X}$ and $\overline{X}^*$ often vary over a wide range. In such cases, the standard deviation statistics associated with the larger mean recovery values will dominate the regression lines. This will produce relatively larger errors in the estimates of S and S_r at lower mean recovery values. Therefore, a weighted least-squares technique was also used to establish the values of the parameters d, e, f and g in Equations (5) and (6). The weighted least-squares technique involves fitting regressions of the form shown in Equations (7) and (8) using

$$S/\overline{X} = d\,(1/\overline{X}) + e. \tag{7}$$

$$S_r/\overline{X}^* = f\,(1/\overline{X}^*) + g \tag{8}$$

the ordinary least-squares algorithm to obtain estimates for the parameters d, e, f and g. As before, the desired forms, Equations (5) and (6), are produced by multiplying both sides of the final regressions by $\overline{X}$ and $\overline{X}^*$ respectively.

COMPARISON OF RECOVERY AND PRECISION ACROSS WATER TYPES

It is possible that the recovery and precision of USEPA Method 200.0, Atomic Asorption Spectroscopy depends upon the type of water being analyzed. The summary statistics $\bar{X}$, S and S_r are calculated separately for each concentration level within each water type. They can be compared across water types in order to obtain information about the effects of water type on recovery and precision. However, use of the summary statistics in this manner has several disadvantages. First, it is cumbersome since there are 12 mean recovery statistics ($\bar{X}$) (six concentrations times distilled water + 6 concentrations times natural water), 12 overall precision statistics (S) and 12 single-analyst precision statistics (S_r) calculated for each element. Comparison of these statistics across concentration levels and across water type becomes unwieldy. Second, the statistical properties of this type of comparison are difficult to determine. Finally, due to variations associated with $\bar{X}$, S and S_r, comparisons based on these statistics can lead to inconsistent conclusions about the effect of water type.

An alternative approach, described in detail in Reference (8), has been developed to test for the effects of water type. This alternative approach is based on the concept of summarizing the average effect of water type across concentration levels rather than studying the local effects at each concentration level. If significant differences are established by this alternative technique, then the summary statistics can be used for further local analysis.

The test for the effect of water type is based on the following statistical model. If X_{ijk} denotes the measurement reported by laboratory i, for water type j, and ampul k, then

$$X_{ijk} = \beta_j (C_k^{\gamma_j}) L_i (\epsilon_{ijk}) \qquad \begin{array}{l} i = 1,2, \ldots, n \\ j = 1,2, \ldots, 6 \\ k = 1,2, \ldots, 6 \end{array} \qquad (9)$$

The model components β_j and γ_j are fixed parameters which determine the effect of water type j on the behavior the observed measurements (X_{ijk}). The parameter C_k is the true concentration level associated with ampul k.

The model component L_i is a random factor which accounts for the systematic error associated with laboratory i. The model component ϵ_{ijk} is the random factor which accounts for the within-laboratory error.

The model is designed to approximate the global behavior of the data. The multiplicative structure was chosen because of two important properties. First, it allows for a possible curvilinear relationship between the data (X_{ijk}) and the true concentration level C_k through the use of the exponent γ_j on C_k. This makes the model more flexible in comparison to straight lines models. Second, as will be seen below, there is an inherent increasing relationship between the variability in the data and the concentration level C_k in this model. This property is important because it is typical of interlaboratory data collected under conditions where the true concentration levels vary widely.

Recovery is related directly to the mean or expected value of the measurements (X_{ijk}). The expected value for the data modeled by Equation (9) is:

$$E(X_{ijk}) = \beta_j \cdot C_k^{\gamma_j} \cdot E(L_i \cdot \epsilon_{ijk}) \qquad (10)$$

Precision is related to the variability in the measurements (X_{ijk}). The variance of the data modeled by Equation (9) is

$$Var(X_{ijk}) = (\beta_j C_k^{\gamma_i})^2 \; Var(L_i \cdot \epsilon_{ijk}) \, , \qquad (11)$$

which is an increasing function of C_k.

The effect of water type on the recovery and precision of Method 200.0 is determined by the values of the parameters (β_j) and (γ_j) in Equations (10) and (11). If the (β_j) and (γ_j) vary with j (i.e., vary across water type), then the accuracy and precision of the method also vary across water type.

In order to determine if these parameters do vary across water type and to compare their values, they must be estimated from the laboratory data using regression techniques. Equation (9) represents the basic model. However, taking natural logarithms of both sides of Equation (9), the following straight line regression model is obtained,

$$\ln X_{ijk} = \ln \beta_j + \gamma_j \ln C_k + \ln L_i + \ln \varepsilon_{ijk} \qquad (12)$$

which can be analyzed using standard linear model analysis techniques. The parameter $\ln \beta_j$ is the intercept and γ_j the slope of the regression line associated with water type j. It is assumed that $\ln L_i$ is normally distributed with mean 0 and variance σ_L^2, that $\ln \varepsilon_{ijk}$ is normally distributed ith mean 0 and variance σ_ε^2 and that the ($\ln L_i$) and ($\ln \varepsilon_{ijk}$) terms are independent.

Based on Equation (12) the comparison of water types reduces to the comparison of straight lines. Distilled water is viewed as a control, and its linear regression is compared directly to the linear regression for recoveries from natural water.

Using the data on the log-log scale and standard linear regression techniques, the paramaters $\ln \beta_j$ (and hence β_j) and γ_j can be estimated. The estimates are then used to test the null hypothesis that there is no effect due to water type. The formal null and alternative statistical hypotheses H_0 H_A are given by

$$H_0\text{:} \quad \ln \beta_j - \ln \beta_1 = 0 \text{ and } \gamma_j - \gamma_1 = 0 \text{ for } j = 2,3,4,5,6 \qquad (13)$$

Versus

$$H_A\text{:} \quad \ln \beta_j - \ln \beta_1 \neq 0 \text{ and/or } \gamma_j - \gamma_1 \neq 0 \text{ for some } j = 2,3,4,5,6 \qquad (14)$$

The test of null hypothesis H_0 against the alternative hypothesis H_A is based on an F-statistic derived from standard linear model theory. The probability of obtaining a value of an F-statistic as large as the value which was actually observed (F OBS), denoted by $P(F > F\ OBS)$, is calculated under the assumption that H_0 is true. The null hypothesis H_0 is rejected in favor of H_A if $P(F > F\ OBS)$ is less than 0.05.

If H_0 is rejected, then some linear combination of the differences $\ln \beta_j - \ln \beta_1$ and $\gamma_j - \gamma_1$ is statistically different from zero. However, this does not guarantee there will be a statistically significant direct effect attributable to any specific water type since the overall F-test can be overly sensitive to minor systematic effects common to several water types. The effect due to a specific water type is judged to be statistically significant only when one or more of the differences $\ell n\ \beta_j - \ell n\ \beta_1$ and/or $\gamma_j - \gamma_1$ is statistically different from zero. This is determined by checking the simultaneous 95 percent confidence intervals which are contructed for each of these differences. Each true difference can be stated to lie within its respective confidence interval with 95 percent confidence. If zero is contained within the confidence interval, then there is no evidence that the corresponding difference is significantly different from zero.

If at least one of the confidence intervals for the differences $\ell n\ \beta_j - \ell n\ \beta_1$ or $\gamma_j - \gamma_1$ fails to include zero, then the statistical significance of the effect due to water type has been established. However, establishment of a statistically significant effect due to water type does not necessarily mean that the effect is of practical importance. Practical importance is related to the size and interpretation of the difference.

The interpretation of the differences involves comparing the mean recovery and standard deviation of the (X_{ijk}) data for each water type to the mean recovery and standard deviation obtained for distilled water. These comparisons are made on a relative basis. The mean recovery for water type j is given by Equation (10). The mean recovery for water type j is compared to that for distilled water (j=1) on a relative basis by

$$\frac{E(X_{ijk})}{E(X_{ijk})} = \frac{\beta_j\ C_k^{\ \gamma_j}\quad E(L_i \cdot \varepsilon_{ijk})}{\beta_1\ C_k^{\ \gamma_1}\quad E(L_i \cdot \varepsilon_{i1k})} = \frac{\beta_j}{\beta_1}\ C_k^{\ \gamma_j - \gamma_1} \qquad (15)$$

(The ratio of the standard deviations would be equivalent to Equation (14) and therefore the interpretation of the effect on precision is the same as that for the effect on mean recovery.)

The ratio in Equation (15) is a measure of the relative difference in mean recovery between water type j and distilled water. It is composed of two parts (a) β_j/β_1, which is independent of the true concentration level, i.e., the constant bias, and (b) $C_k^{\gamma_j - \gamma_i}$ which depends upon the true concentration level (i.e., the concentration dependent bias). If $\gamma_j - \gamma_1$ is zero, then the relative difference in mean recovery is just β_j/β_1 which is independent of concentration level C_k. It can then be stated that the mean recovery of water type j is $(\beta_j/\beta_1) \times 100$ percent of the mean recovery for distilled water. If $\gamma_j - \gamma_1$ is not zero, then the mean recovery of water type j is $((\beta_j/\beta_1)\ C_k^{\gamma_j - \gamma_1}) \times 100$ percent of that for distilled water, and therefore depends upon the true concentration level C_k.

In order to illustrate these points, consider the following example. Suppose that a significant F-value has been obtained and the confidence intervals for all the differences contain zero except for water type 5. For water type 5, the point estimate for $\ln \beta_5 - \ln \beta_1$ is -0.38 and the confidence interval for $\ln \beta_5 - \ln \beta_1$, is (-0.69, -0.07). The points estimate for $\gamma_5 - \gamma_1$ is 0.07, and the confidence interval for $\gamma_5 - \gamma_1$ is (-.0.04, 0.18). In this case a statistically significant effect due to water type has been established which involves only water type 5. The practical significance of this effect is judged by considering Equation (15). The ratio of mean recoveries for water type 5 and distilled water is given by:

$$\frac{E(X_{i5k})}{E(X_{i1k})} = \frac{\beta_5}{\beta_1} \quad C_k^{\gamma_5 - \gamma_1} \tag{16}$$

and the ratio of the standard deviation is given by

$$\sqrt{\frac{Var(X_{i5k})}{Var(X_{i1k})}} = \frac{\beta_5}{\beta_1} \quad C_k^{\gamma_5 - \gamma_1} \tag{17}$$

Since the confidence interval for $\gamma_5 - \gamma_1$ contains zero this difference is assumed to be insignificant and is set to zero. Therefore, Equations (16) and (17) reduce to β_5/β_1. The point estimate for $\ln \beta_5 - \ln \beta_1$ was -0.38. Therefore, the point estimate for β_5/β_1 is 0.68, and the mean recovery for water type 5 is estimated to be 68 percent of the mean recovery for distilled water. Similarly the standard deviation for the data for water type 5 is estimated to be 68 percent of the standard deviation for distilled water.

Since the 95 percent confidence interval for $\ln \beta_5 - \ln \beta_1$ was (0.69, -0.07), any value in the interval (0.50, 0.93) is a reasonable estimate for β_5/β_1, and the mean recovery (standard deviation) for water type 5 can be claimed to be from 50 percent to 93 percent of the mean recovery (standard deviation) for distilled water. The practical significance of the effect due to water type 5 would depend upon the importance of a mean recovery (or standard deviation) observed for distilled water.

Results from the comparison between waters in this study are given in Table 71. The only analytes for which these results suggest a statistically significant difference (probability less than 0.05) are iron, manganese and selenium. Only for manganese, however, it is clear that the clopes or intercepts for the two waters clearly differ from each other at the five percent significance level.

USEPA METHOD STUDY 7, TRACE METALS BY AA/COLORIMETRY

TABLE 71: COMPARISON BETWEEN DISTILLED AND NATURAL WATER REGRESSIONS

			Significant Difference Between:	
Analyte	Overall F	Probability	Slopes	Intercepts
Aluminum	0.15	0.861	No	No
Arsenic	0.10	0.905	No	No
Cadmium	0.13	0.880	No	No
Chromium	2.91	0.056	No	No
Copper	2.02	0.135	No	No
Iron	4.20	0.016	No	No
Lead	1.39	0.250	No	No
Manganese	8.85	0.000	Yes	Yes
Selenium	4.57	0.012	No	No
Zinc	0.05	0.956	No	No

DISCUSSION AND CONCLUSIONS

The statistical results of the study are fully detailed in Tables 52-69 in Appendix D and Figures 1-20 on pages 38-57. However, a brief summary for each analyte follows:

Aluminum

At the 500-1200 ug/L levels, recoveries by direct aspiration were an excellent 96-103%, with overall relative standard deviation (RSDs) of 17-43% and single-analyst RSD of 12-19%. At the lowest level tested, 15-35 ug/L, mean recoveries averaged 236-1270% and overall RSD ranged from 69-119%, demonstrating the inadequacy of direct analysis at this concentration level. By comparison, concentration by evaporation for the low level samples showed improved but still high recoveries of 176-245% in distilled water and low level recoveries of 45-80% in natural waters. Overall RSDs from the concentration data were also improved but with somewhat higher RSD levels of 61-82% for distilled water than the 22-52% overall RSDs for natural waters.

Arsenic

Recoveries of arsenic by the silver diethyldithiocarbamate colorimetric method were similar (75-89%) over the entire range tested, 20-292 ug/L, for both distilled and natural waters. In contrast, the overall RSDs reduced with increased concentrations of arsenic for both distilled and natural waters; 42-51% at 20-29 ug/L levels, 28-33% at 67-80 ug/L levels and 20-27% at 266-290 ug/L levels of arsenic.

Cadmium

Recoveries of cadmium by direct aspiration were proportionately lower than with the concentration technique, both in natural and distilled water. At cadmium levels of 14-18 ug/L, recoveries were 104-118% with overall RSDs of

33-43%, while at cadmium levels of 71-78 ug/L, recoveries were 94-99% with overall RSDs of 12-19%. At low cadmium levels of 1.4-2.8 ug/L, recoveries by direct aspiration were 125-312% with overall RSDs of 70-97%, suggesting direct analysis is inadequate at this level.

By comparison, at cadmium levels of 1.4-2.8 ug/L, recoveries by extraction were 97-135% with overall RSDs of 43-67%. Similarly, recoveries by concentration were 97-187% with overall RSDs of 24-57%.

Chromium

Recoveries of chromium at the 74-407 ug/L levels by direct aspiration were similar in distilled and natural waters; 98-103% with overall RSDs of 14-27%.

At the lowest level tested (7.4-15 ug/L), recoveries by direct aspiration were 139-223% with overall RSDs of 38-87%, again similar for distilled and natural waters, and suggesting direct analysis is inadequate at this level. By contrast, recoveries by concentration and chelation extraction were improved; 90-117% with 13-24% overall RSD, and 89-124% with overall RSDs of 30-59%, respectively.

Copper

The recovery of copper by direct aspiration over the concentration range of 60-332 ug/L showed good recoveries of 93-104% with overall RSDs of 9-28%. Recovery by direct aspiration at the lower levels of 7.5-12 ug/L showed recoveries of 161-207% in natural and distilled waters, with overall RSDs of 67-88%, indicating its inadequacy at such a low level.

By comparison, chelation/extraction at the 7.5-12 ug/L levels of copper showed improved recoveries of 97-121% with overall RSDs of 45-55%, in natural and distilled waters.

Recoveries of 7.5-12 ug/L by the concentration procedure showed similar recoveries of 88-149% but with lower overall RSDs of 29-47% in natural and distilled waters.

Iron

There were excellent recoveries of iron with the direct aspiration method, (99-107%) with 7-23% average RSD at the 350-870 ug/L levels in distilled and natural waters. At the low iron concentration of 10-24 ug/L, recoveries by direct aspiration were very high (239-1241%) with 79-138% overall RSD, demonstrating the inappropriateness of direct analysis at such low levels.

In comparison, recoveries by the extraction procedure at the iron concentration 10-24 ug/L were 127-371% with a 43-80% overall RSD while recoveries by the concentration procedures were 95-226% with overall RSDs of 36-53% in distilled and natural waters.

Lead

Analyses for lead by direct aspiration showed good recovery of 105-119% and overall RSD of 28-37% at 84-101 ug/L level and excellent recovery of 99-104% and overall RSD of 12-22% at 334-367 ug/L level.

At the lower levels of 25-37 ug/L, recoveries and variability of direct analysis increased markedly with ranges of 142-204% recovery, and 70-90% RSD, as would be expected for results below the detection limit of direct analysis. Contrariwise, recoveries at the 25-40 ug/L level for extraction were an excellent 96-102%, but with a continued variability of 45-55% RSD. Recoveries by concentration were biased high at 110-125%, and with 25-62% RSD. Single laboratory % RSDs were about 1/2 of overall % RSD for all three procedures. An examination of the evaluated data in Table 41 through 43 shows that the high percent recoveries for all three procedures were due largely to a few extreme values which were not rejected by the outlier routines.

Manganese

At manganese levels of 84-469 ug/L, recoveries by direct aspiration were excellent in both distilled and natural waters, at 97-104%, with relatively small overall RSDs of 14-17% at 84-106 ug/L and 5.4-8.4% at 426-469 ug/L levels of manganese.

Recovery of manganese at levels of 11-17 ug/L by direct aspiration, however, were higher at 110-196% with overall RSDs of 41-96%, indicating how questionable direct analysis is at this level. By comparison, the extraction technique also showed rather poor recoveries of 91-227% with overall RSDs of 45-117%, while recoveries by concentration improved to 76-100% with overall RSDs of 10-32%.

Selenium

Contrary to arsenic, percent recoveries of selenium by the diaminobenzidine colorimetric method, were reduced with increased concentrations of selenium both in distilled and natural waters. At the 4.7-7.8 ug/L level of selenium recoveries were 75-93%, with overall RSDs of 18-38%. At the 12-19 ug/L levels, recoveries were 60-77% with 35-64% RSD. Similarly at the 43-49 ug/L levels, percent recoveries were 59-66% with overall RSDs of 40-56%.

Zinc

Direct aspiration analyses for zinc showed good recovery (99-102%) at the 56-310 ug/L levels, with 10-29% overall RSD. However, at the lowest levels (7-11 ug/L), recoveries ballooned to 182-252%, with overall RSDs of 81-102%, demonstrating the questionable value of direct analyses at such a low concentration level. The low-level statistics were due largely to the extreme values which were not rejected in outlier tests.

Comparison of analytical results for the low-level zinc samples (7-11 ug/L) by direct aspiration, extraction, and concentration showed similar recoveries of 182-252% for direct aspiration, 98-283% for extraction, and 120-205% for concentrations with overall RSDs of 44-109%. One must conclude that the lowest levels tested were marginal for a number of laboratories.

Percentage of Data Considered Outliers

A question that commonly arises regarding statistical analysis of method study data is what percentage of the responses were considered outliers and omitted in estimating the statistical characteristics of the method when properly performed. Overall, 6291 responses were evaluated in this study for the analytical conditions being considered, i.e., direct measurement at all three concentration levels, and, where applicable, extraction and concentration at the low-concentration level, with up to 50 laboratories reporting. Of this total, 16.8% of the values were rejected as less than values, zeros or statistical outliers. The rejection percentages for recovery from distilled and natural water were similar, 17.0% and 16.7%, respectively. Overall rejection percentages differed somewhat among the analytes studied, from a high of 23.9% for selenium to a low of 12.4% for manganese. Where the rejection percentage was highest it was usually caused by problems quantifying results for the low-concentration samples, i.e., frequent zeros and less thans, particularly from direct aspiration. The exception is the selenium method, which produced the highest percentage of rejected data by a slight margin over cadmium (23.0%) and aluminum (21.7%), primarily because of a consistent high bias in the selenium data from several laboratories. These results support the previous conclusion that the lowest concentrations studied were too low for proper quantitation by direct aspiration, but do not otherwise suggest general problems.

Natural Water Used in the Study

Another interesting sidelight is the diversity of the "natural water" each participant chose to use. Of the 119 laboratories reporting recoverjes from what has been called throughout this report a "natural water", 97 described the source as a river, stream, creek, pond, lake, reservior, spring or well, 15 described it as a tap water, 4 a salt water, and 3 described some type of effluent.

Interpreting Results from the Comparison Between Waters

Finally, to understand the results from the comparison between waters, Table 71, it was necessary to develop two more summary tables. Overall precision was summarized in Table 72 for the study analytes, while percent recovery was summarized in Table 73, as shown on the following pages. Entries in the first, second, fourth, fifth, seventh, and eighth columns of both Tables were averaged (or pooled) from the appropriate pair of entries in Tables 52 through 69.

TABLE 72: Summary of Pooled Overall Relative Standard Deviation (RSD)

	Low Pair			Medium Pair			High Pair					Avg. Diff. / Pooled RSD
Analyte	D*	N*	Diff.	D	N	Diff.	D	N	Diff.	Avg. Diff.	Pooled RSD	RSD
Al		NA**		29.35	35.00	5.65	18.35	18.77	0.41	3.03	26.34	0.12
As	49.82	44.67	-5.15	30.08	30.88	0.80	21.59	23.73	2.14	-0.74	35.04	-0.02
Cd		NA		40.47	35.23	-5.24	17.45	13.41	-4.04	-4.64	29.00	-0.16
Cr		NA		18.11	23.90	5.78	14.37	14.51	0.13	2.96	18.14	0.16
Cu		NA		23.18	21.35	-1.82	9.18	11.52	2.34	0.26	17.39	0.01
Fe		NA		12.80	21.18	8.38	7.77	10.52	2.75	5.56	14.00	0.40
Pb		NA		36.12	31.91	-4.21	12.40	20.05	7.65	1.72	26.83	0.06
Mn		NA		14.27	15.88	1.61	6.01	7.47	1.46	1.54	11.70	0.13
Se	25.06	35.34	10.28	43.14	55.40	12.26	40.10	54.22	14.12	12.22	43.50	0.28
Zn		NA		25.09	26.65	1.56	11.80	10.54	-1.26	0.15	19.94	0.01

*Distilled and Natural water samples.

**"NA" means statistics from the low concentration sample pair were not used to fit the regressions in Table 1.

TABLE 73: Summary of Percent Recovery

Analyte	Low Pair			Medium Pair			High Pair			Avg.	Avg. Diff.
	D*	N*	Diff.	D	N	Diff.	D	N	Diff.	Diff.	Pooled RSD
Al		NA**		98.85	97.17	-1.69	98.67	103.19	4.52	1.42	0.05
As	83.73	77.27	-6.46	83.49	81.95	-1.55	86.77	84.97	-1.80	-3.27	-0.09
Cd		NA		110.16	111.80	1.64	96.52	97.10	0.58	1.11	0.04
Cr		NA		102.35	98.95	-3.40	98.74	98.13	-0.61	-2.00	-0.11
Cu		NA		101.14	96.13	-5.01	96.56	94.33	-2.23	-3.62	-0.21
Fe		NA		99.34	106.68	7.34	99.66	100.79	1.14	4.24	0.30
Pb		NA		110.89	111.85	0.96	100.43	103.53	3.11	2.03	0.08
Mn		NA		97.27	102.43	5.16	98.50	99.27	0.77	2.96	0.25
Se	88.06	77.68	-10.38	71.45	67.08	-4.38	65.43	60.43	-5.01	-6.59	-0.15
Zn		NA		100.59	101.55	0.96	99.95	99.66	-0.29	0.33	0.02

*Distilled amd Natural water samples.

**"NA" means statistics from the low concentration sample pair were not used to fit the regressions in Table 1.

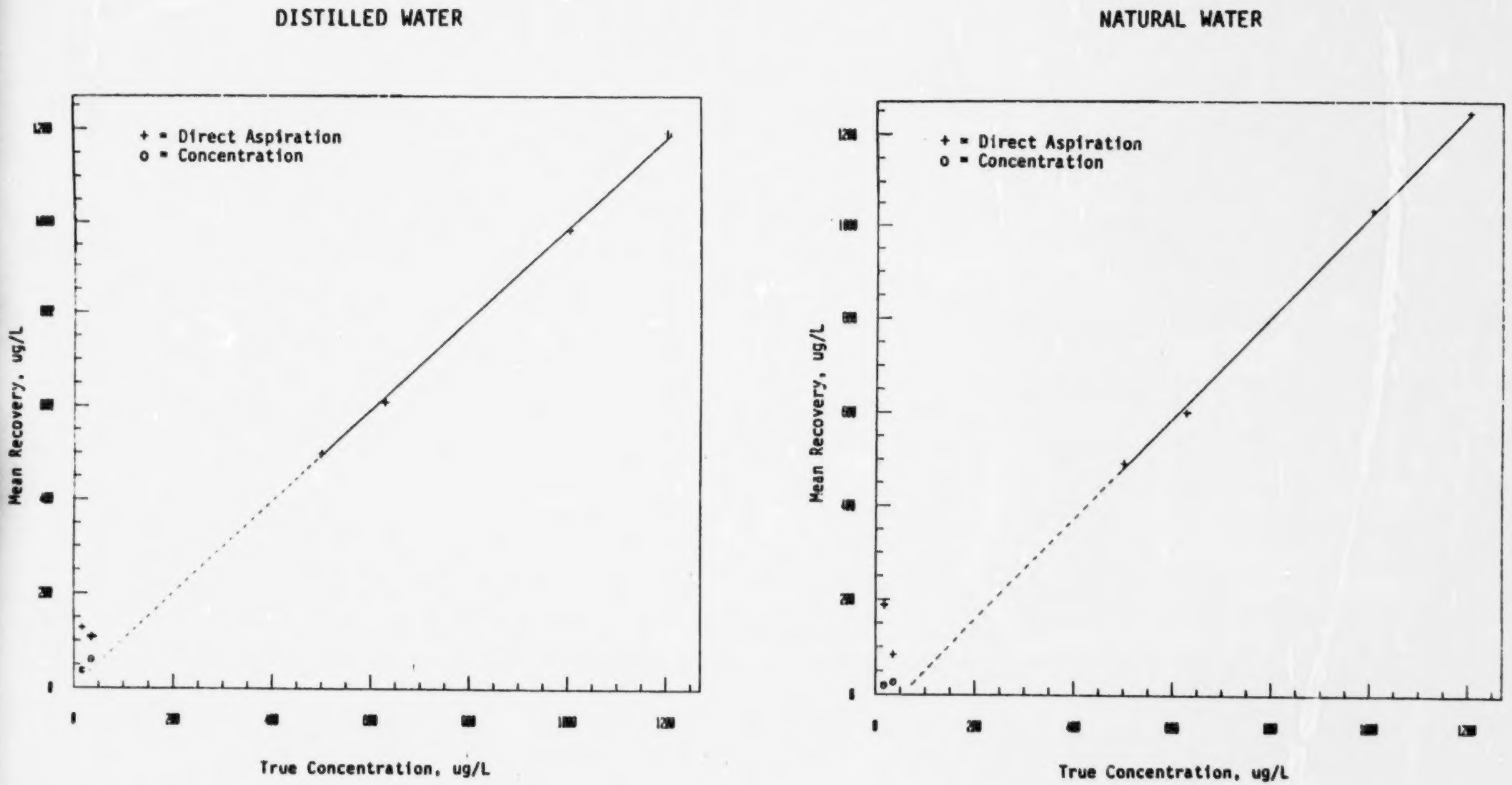
The next to last column of Table 72 shows that manganese has the smallest pooled RSD of all the study analytes and iron is next to the smallest. Since all comparisons between distilled and natural water results, RSD and percent recovery, are measured relative to pooled RSD, test for manganese and iron are going to be the most sensitive to differences.

The last column of Table 72 shows that, relative to their pooled RSD, iron and selenium have the largest average differences between overall RSD estimates for the two waters at the concentrations used the fit the regressions in Table 1, with values of 0.40 and 0.28, respectively. Similarly, Table 73 shows that, relative to the pooled RSD, percent recoveries for the two waters differed most for iron and manganese, with values of 0.30 and 0.25, respectively. Thus it would seem, the statistically significant differences between waters primarily stem from differences in precision of the selenium data, differences in recovery for manganese, and a combination of the two for iron.

Review of the relevant tables and figures suggest that there is no practical difference in the recovery of iron and manganese between the two waters and hence no matrix effect. However, the differences in precision for iron and selenium between the distilled and natural waters do appear of practical importance, suggesting that recoveries of iron and selenium from some natural waters are adversely effected and sample effects are significant.

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

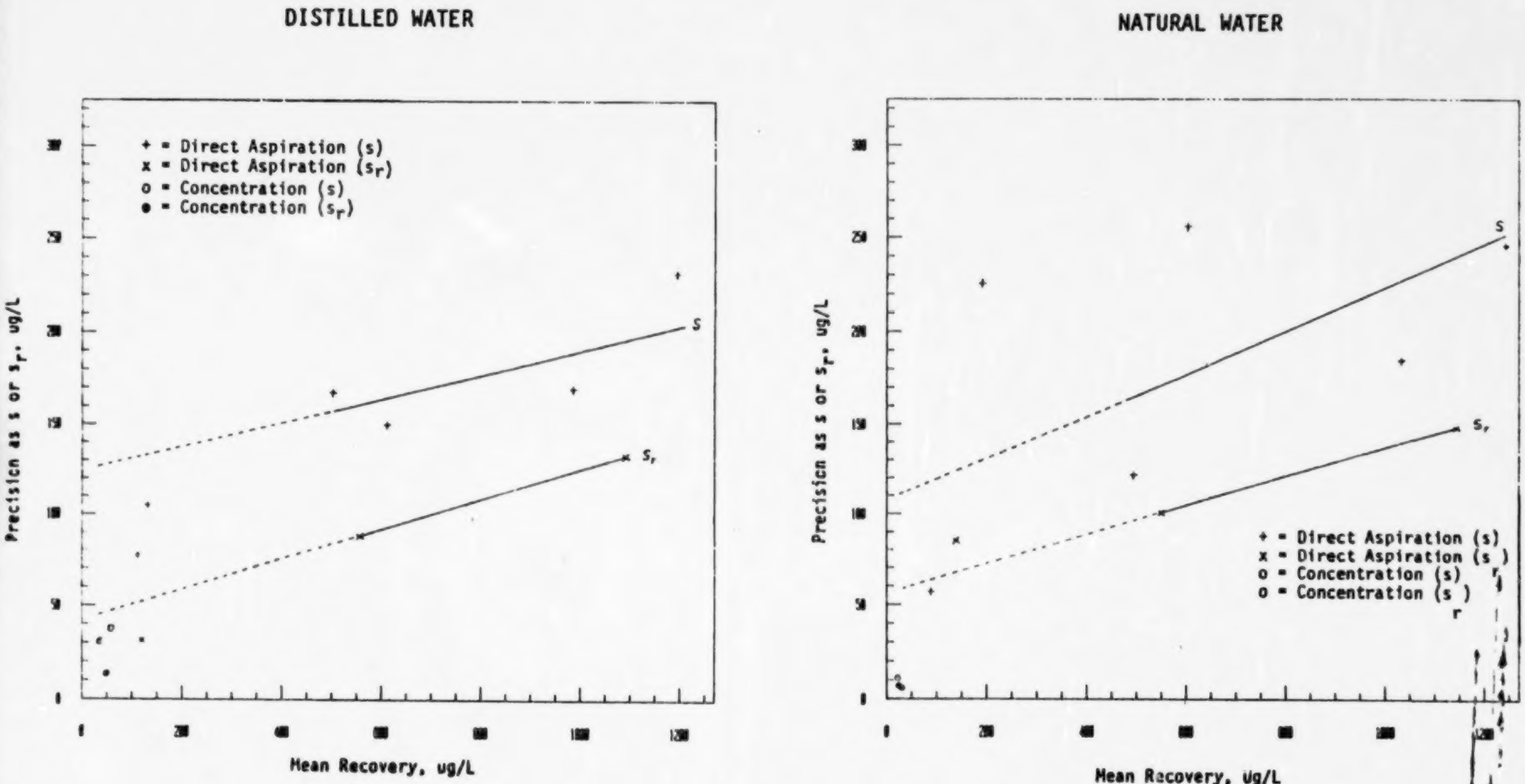
FIGURE / : RECOVERY OF ALUMINUM FROM DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

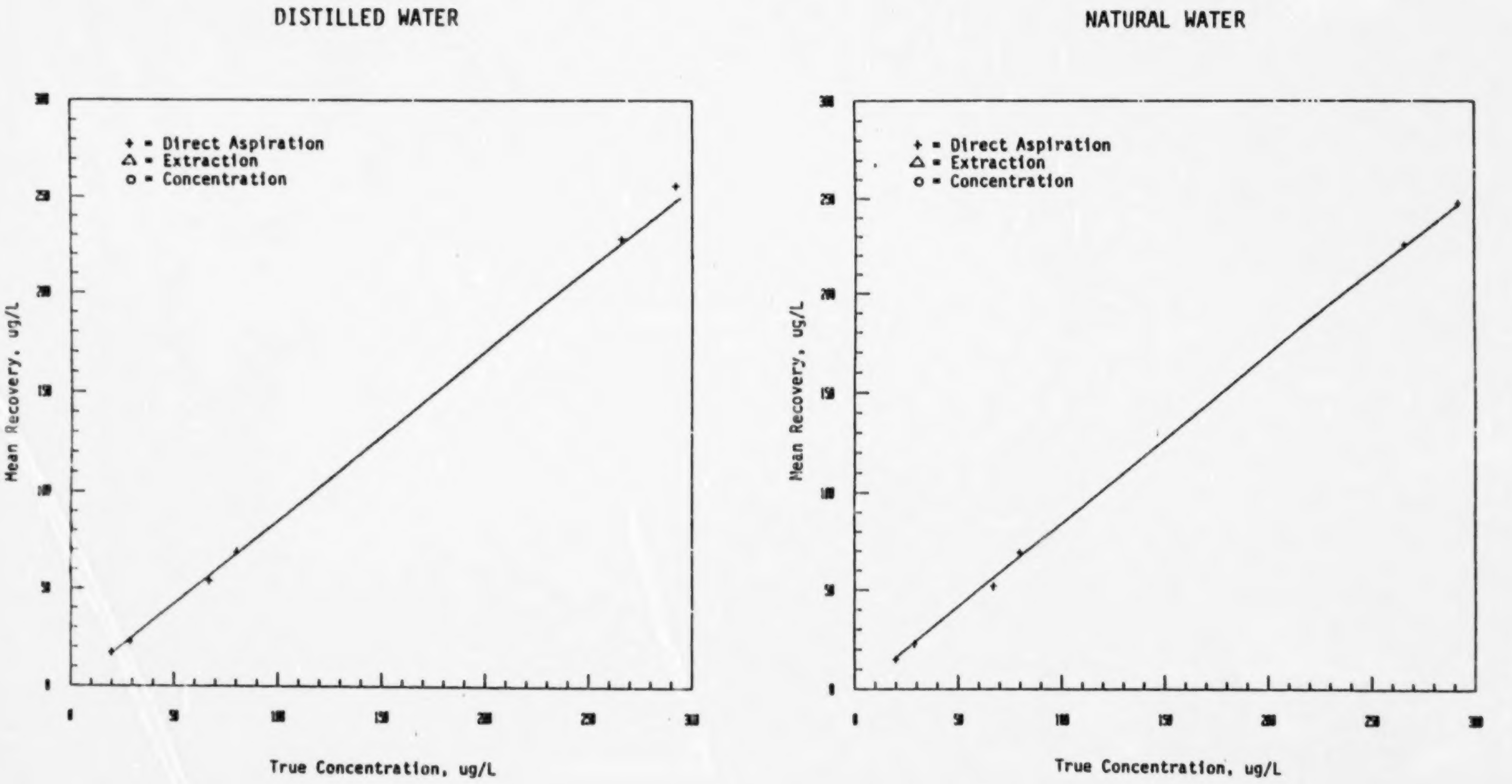
USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

FIGURE 2: PRECISION OF ALUMINUM ANALYSES IN DISTILLED AND NATURAL WATER



USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

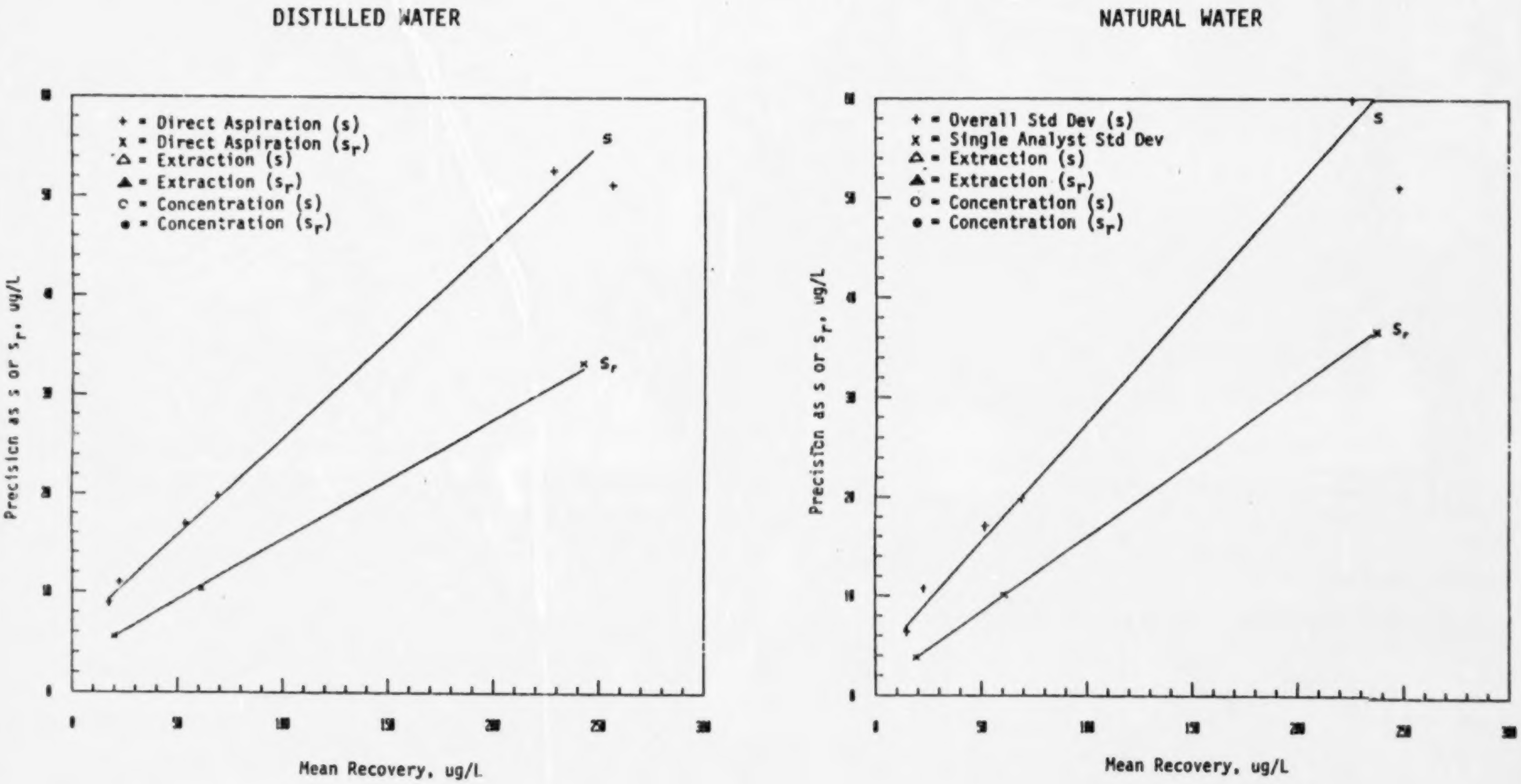
FIGURE 3 : RECOVERY OF ARSENIC FROM DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

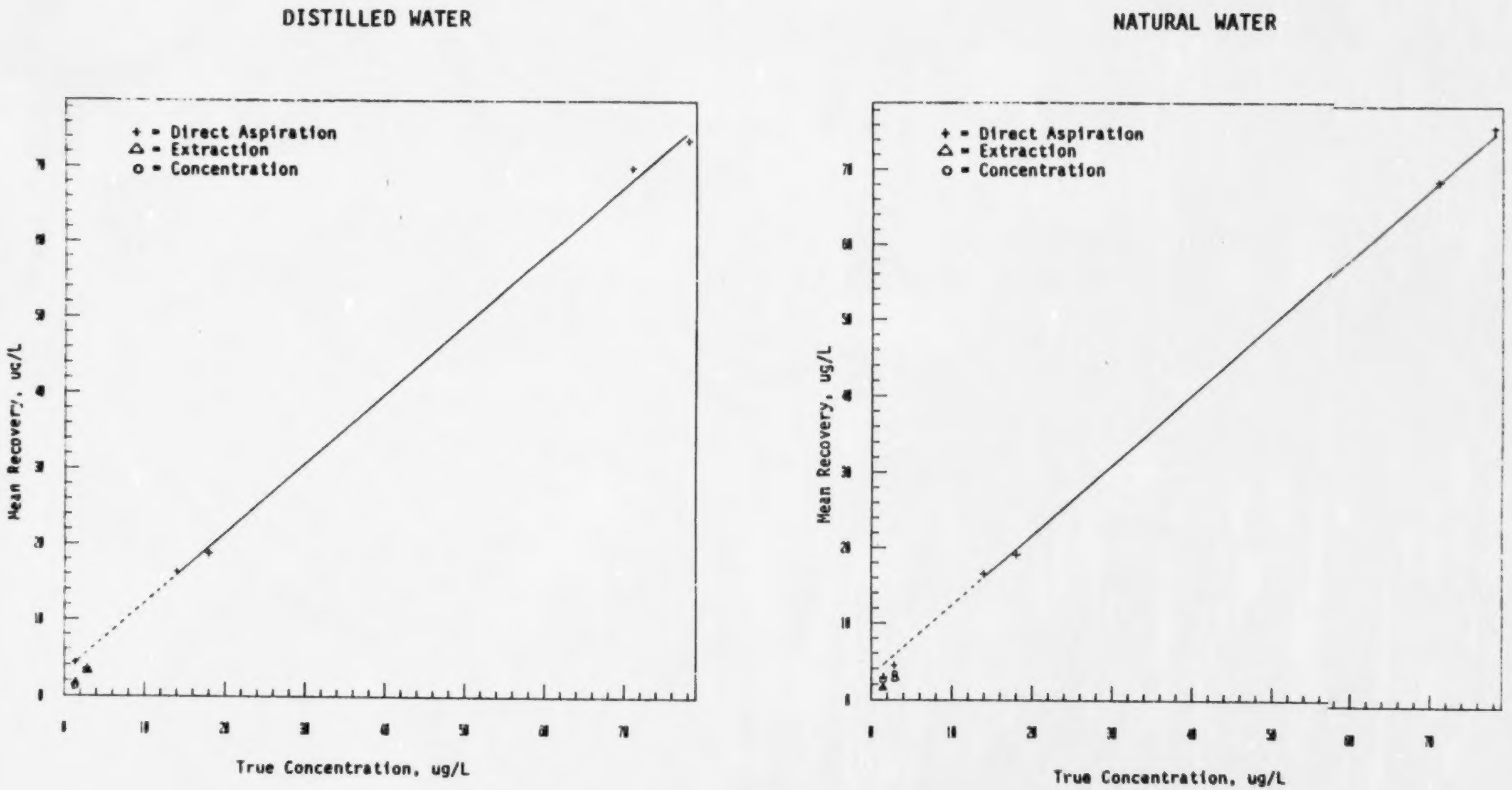
FIGURE 4: PRECISION OF ARSENIC ANALYSES IN DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

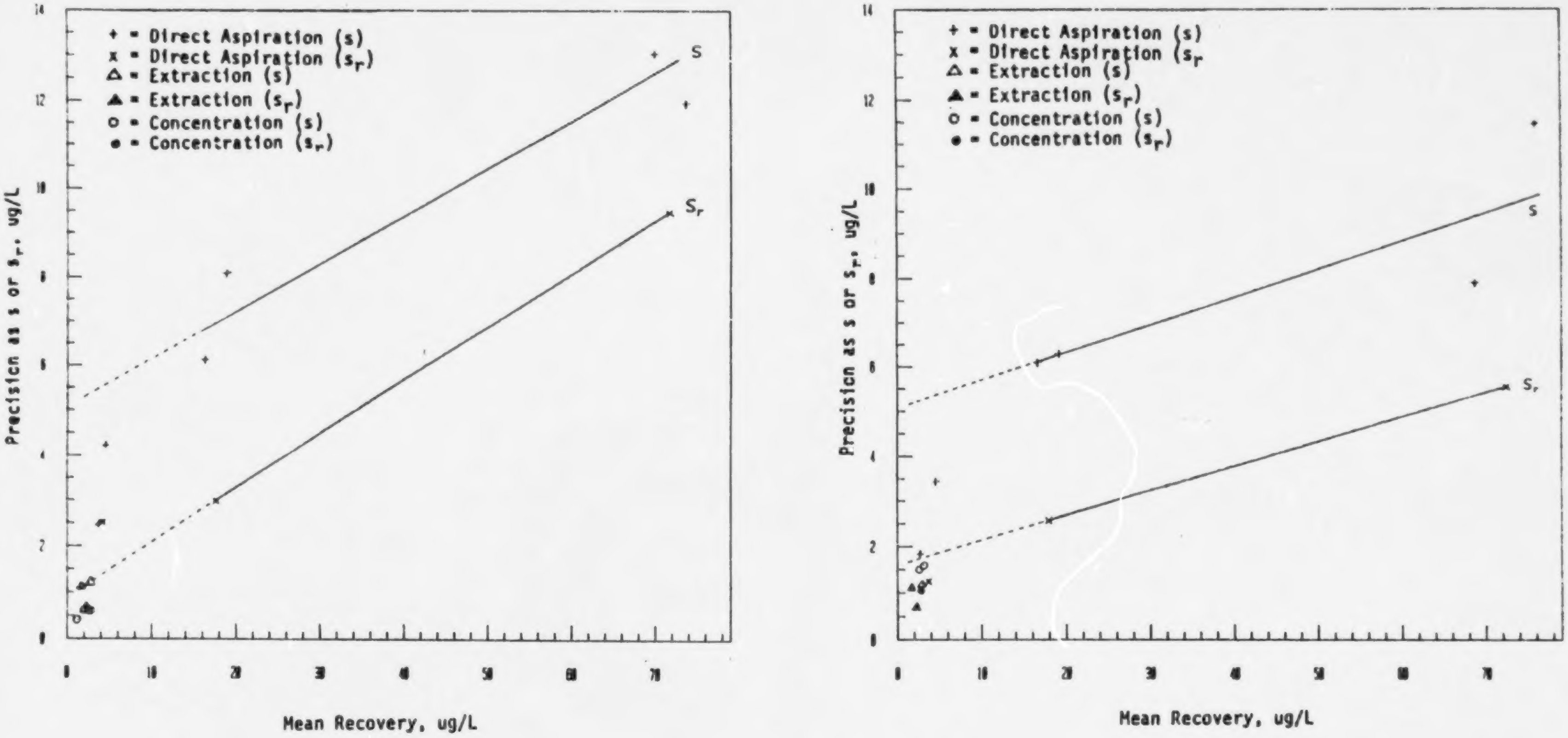
USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

FIGURE 5: RECOVERY OF CADMIUM FROM DISTILLED AND NATURAL WATER



USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

FIGURE 6: PRECISION OF CADMIUM ANALYSES IN DISTILLED AND NATURAL WATER

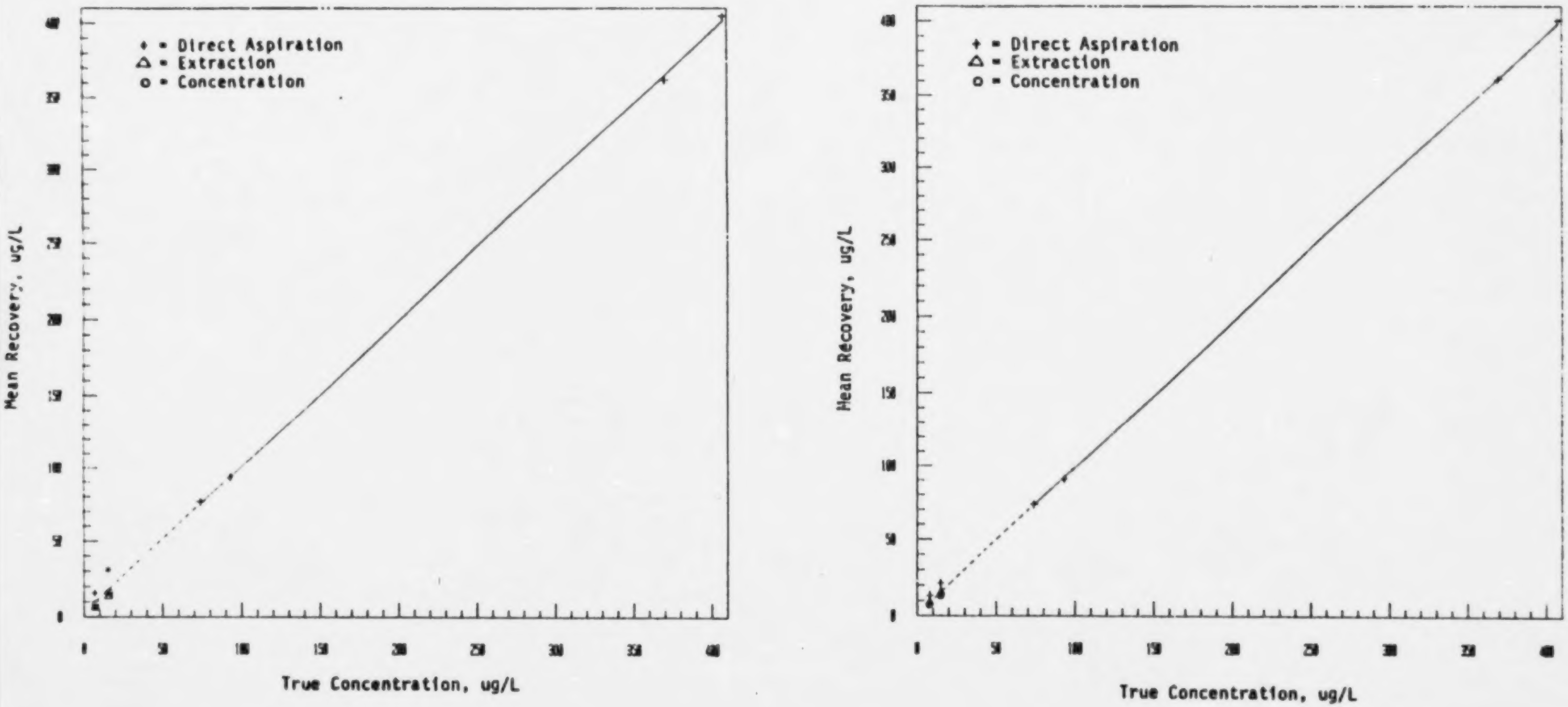


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

FIGURE 7 : RECOVERY OF CHROMIUM FROM DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

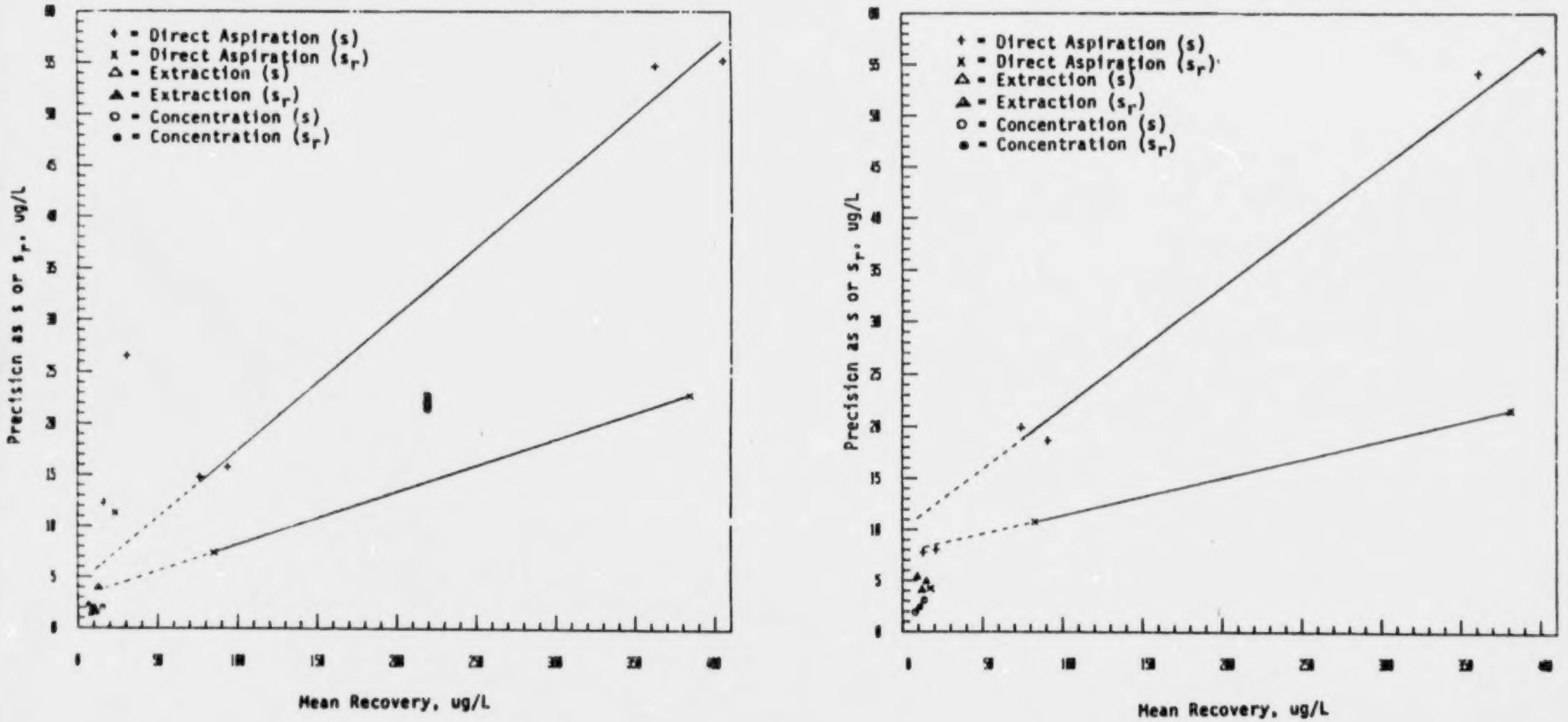


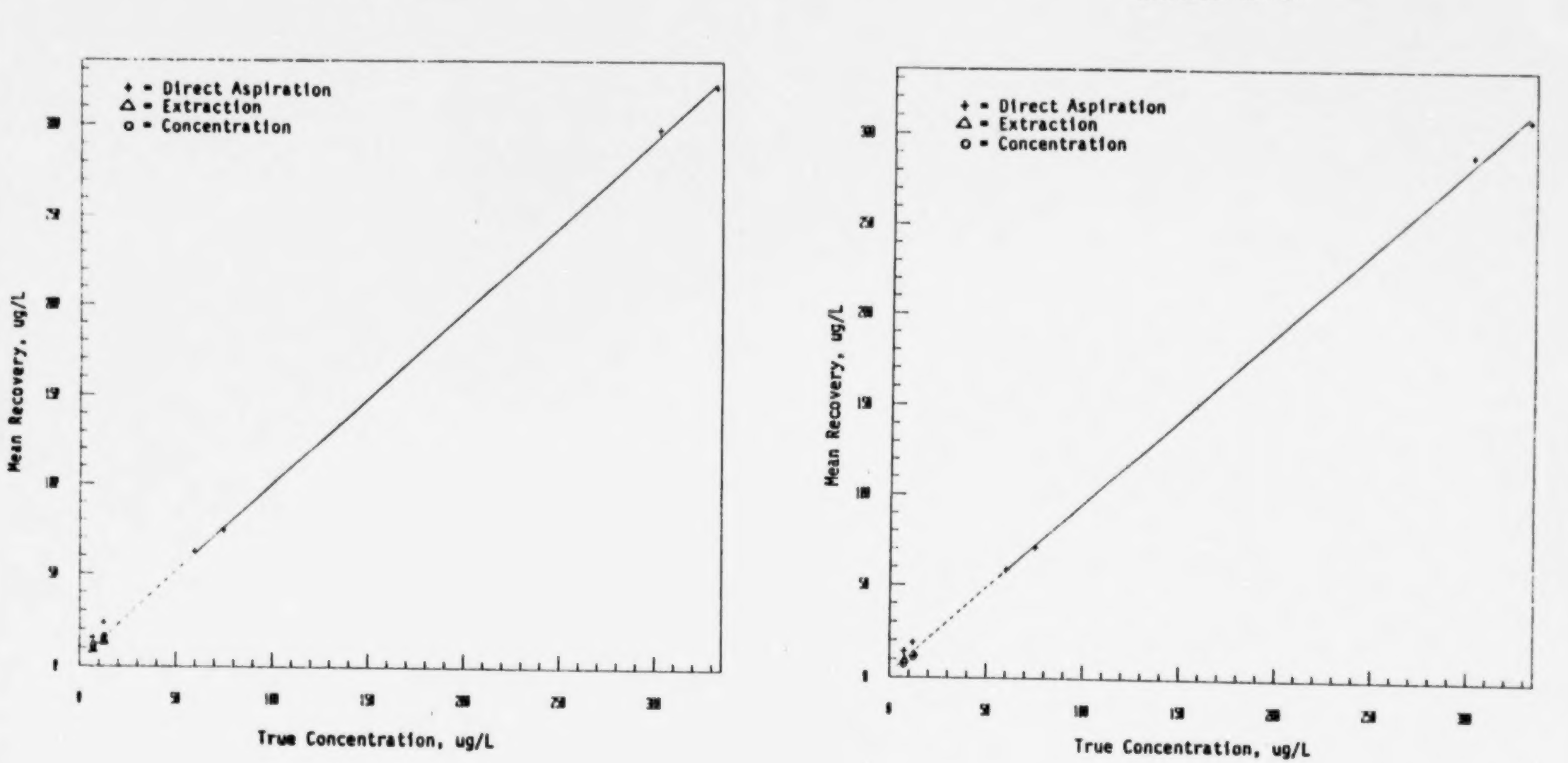
FIGURE 8 : PRECISION OF CHROMIUM ANALYSES IN DISTILLED AND NATURAL WATER

DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

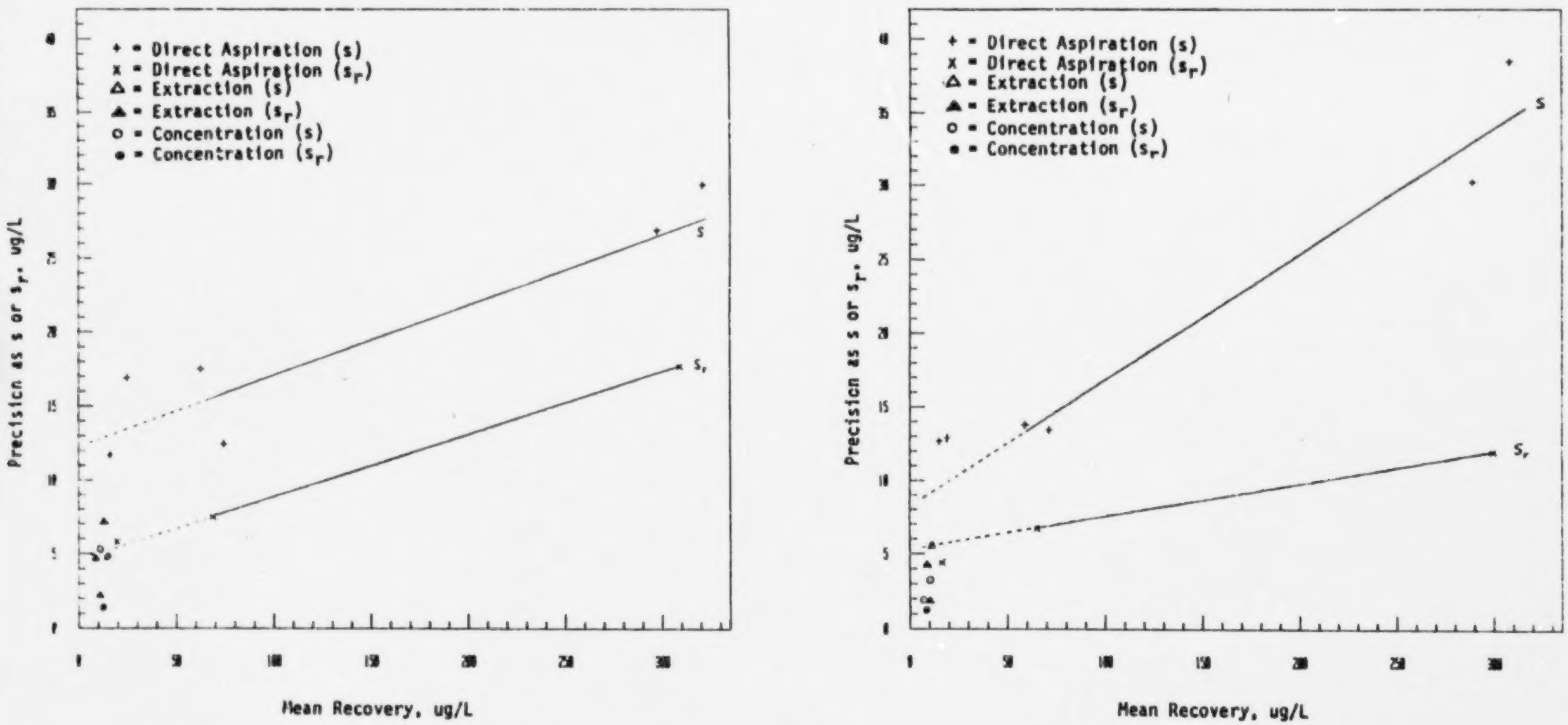
FIGURE 9: RECOVERY OF COPPER FROM DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

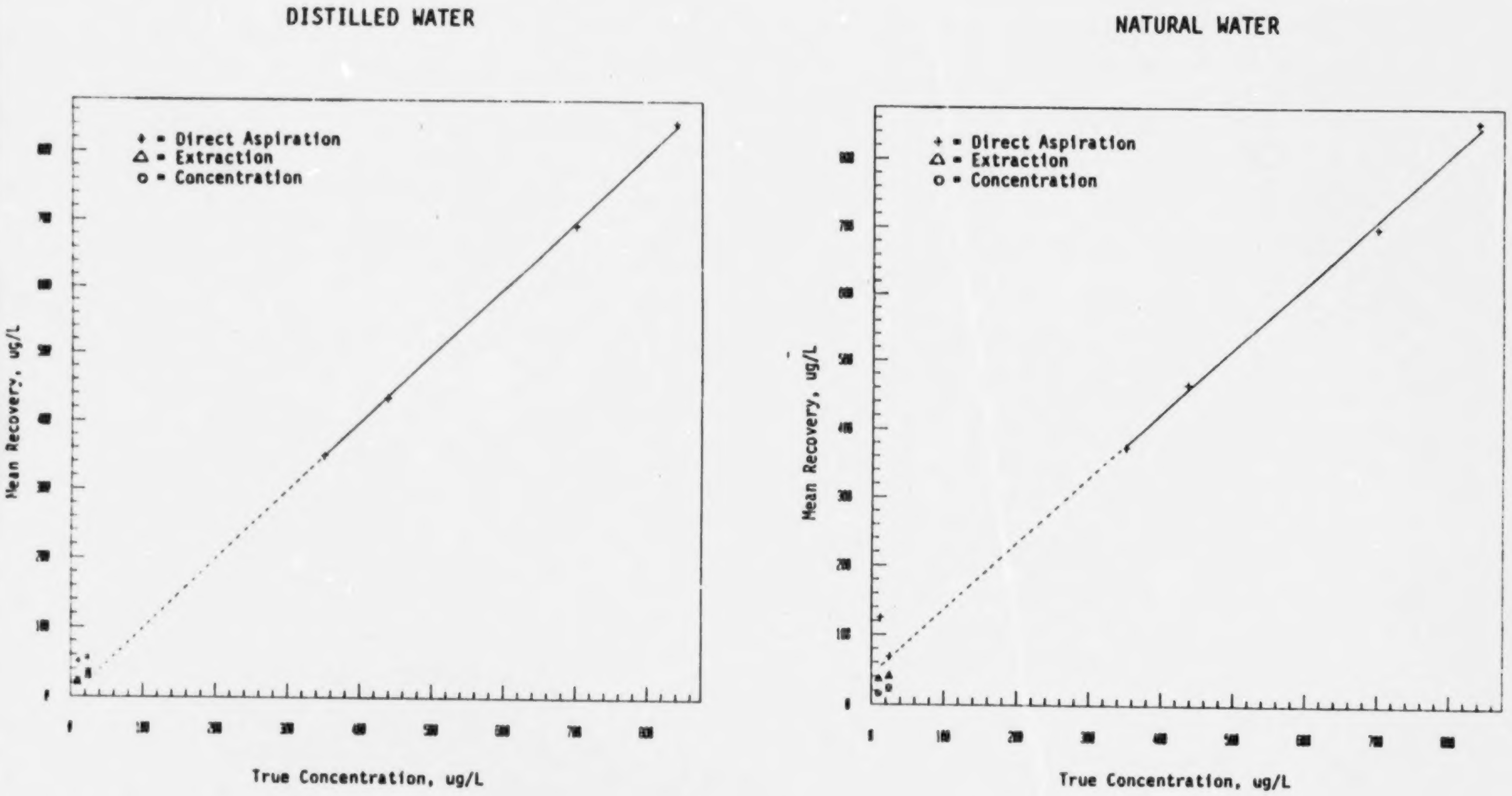
FIGURE 10: PRECISION OF COPPER ANALYSES IN DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

FIGURE //: RECOVERY OF IRON FROM DISTILLED AND NATURAL WATER

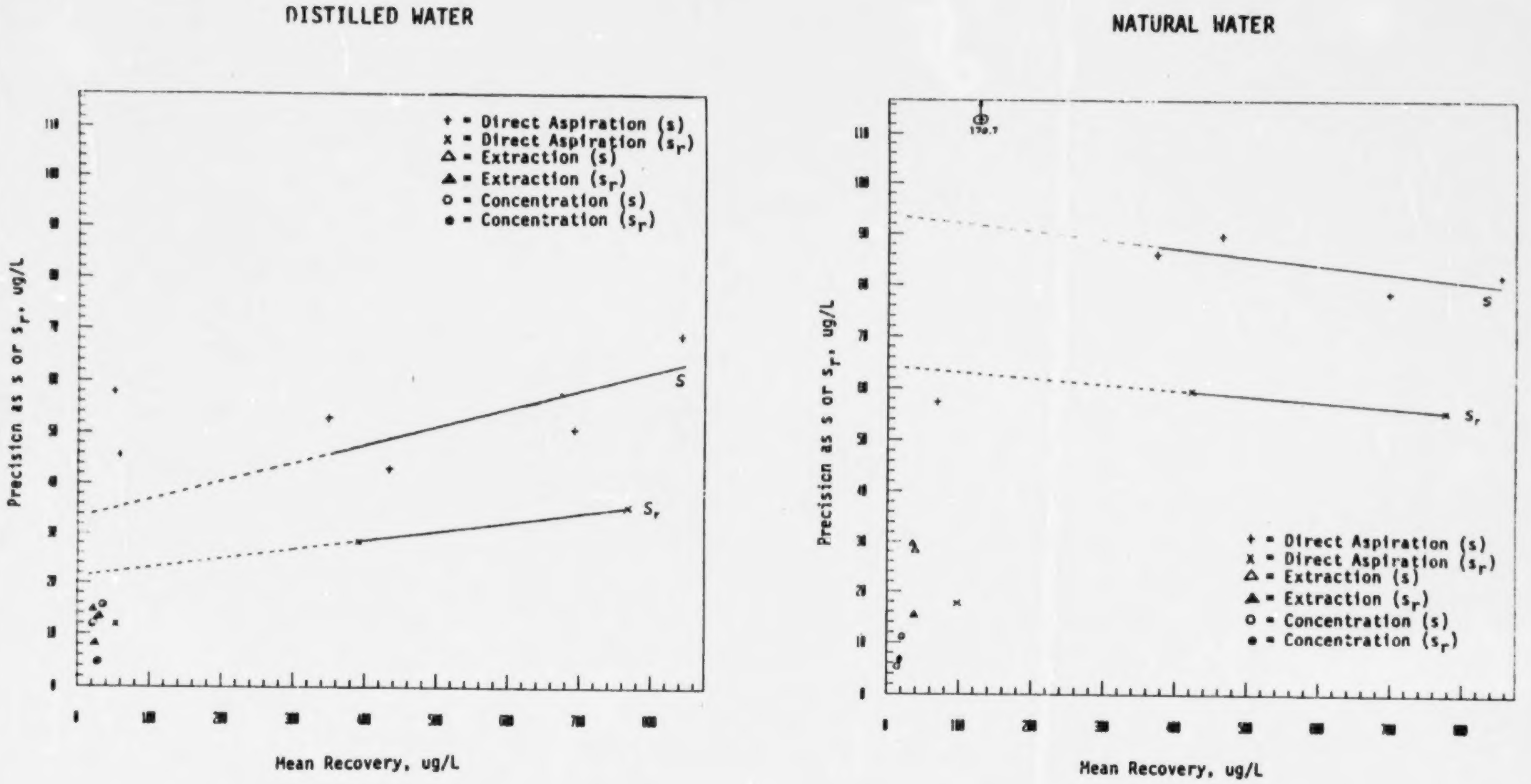


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

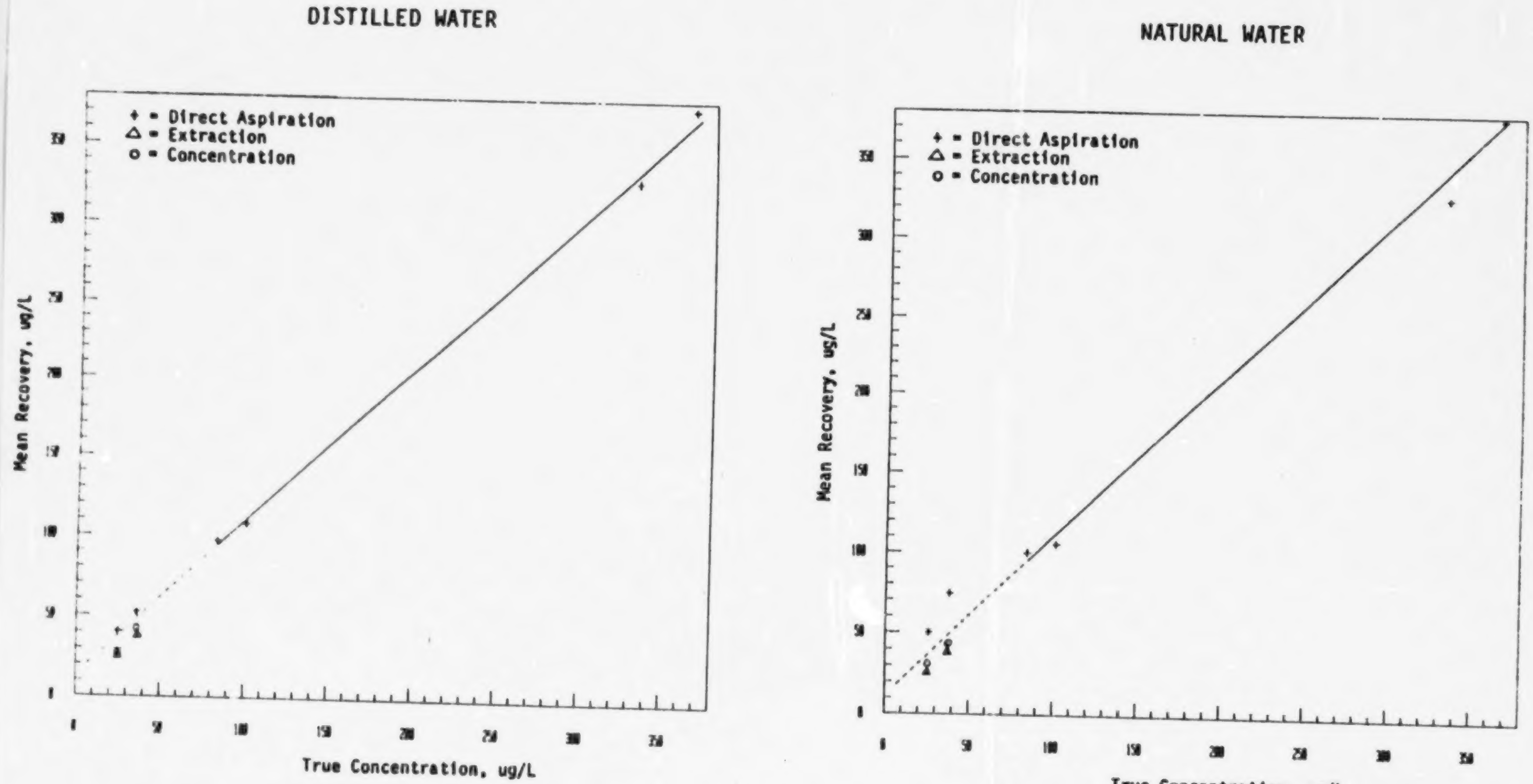
FIGURE /2: PRECISION OF IRON ANALYSES IN DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

FIGURE /3: RECOVERY OF LEAD FROM DISTILLED AND NATURAL WATER

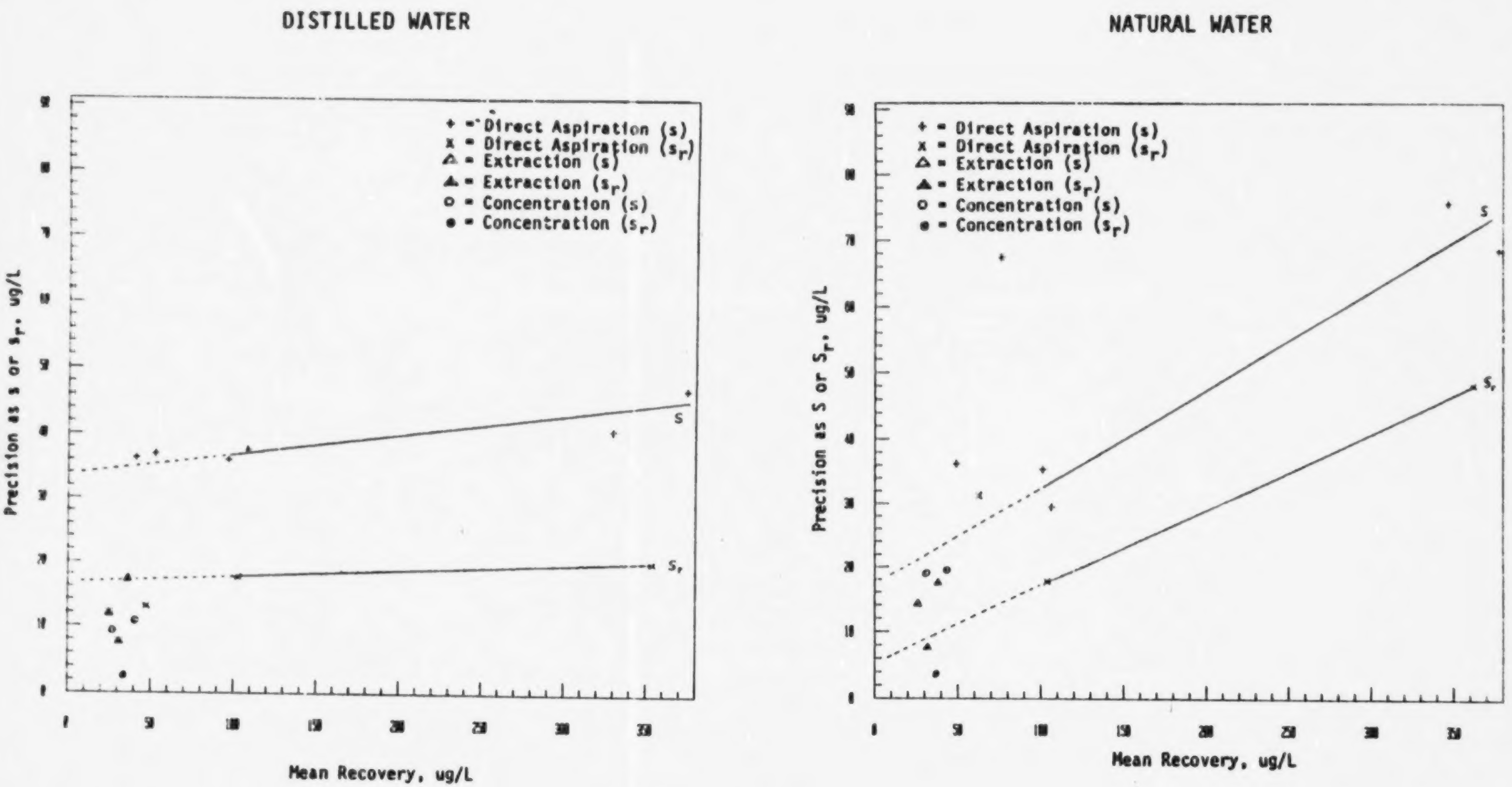


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

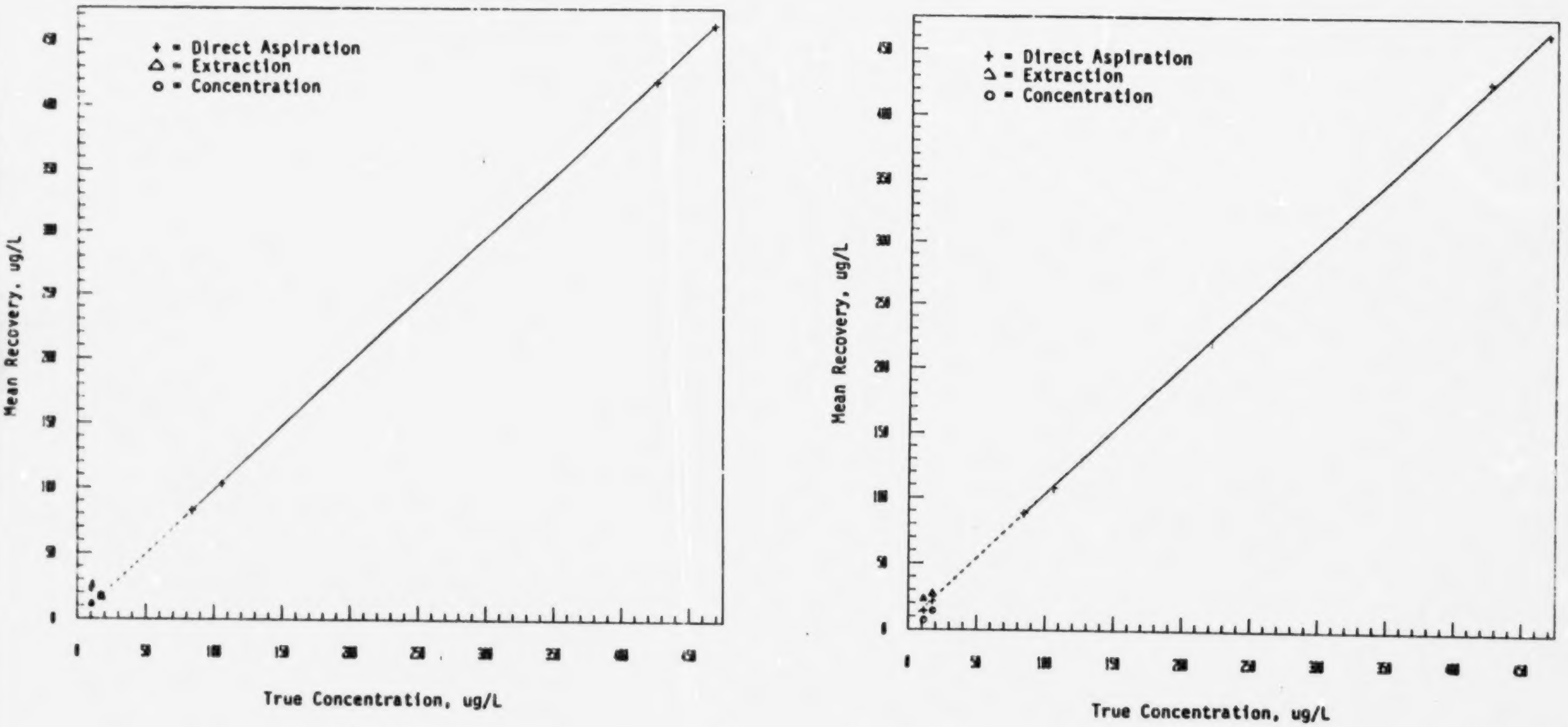
FIGURE 14: PRECISION OF LEAD ANALYSES IN DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

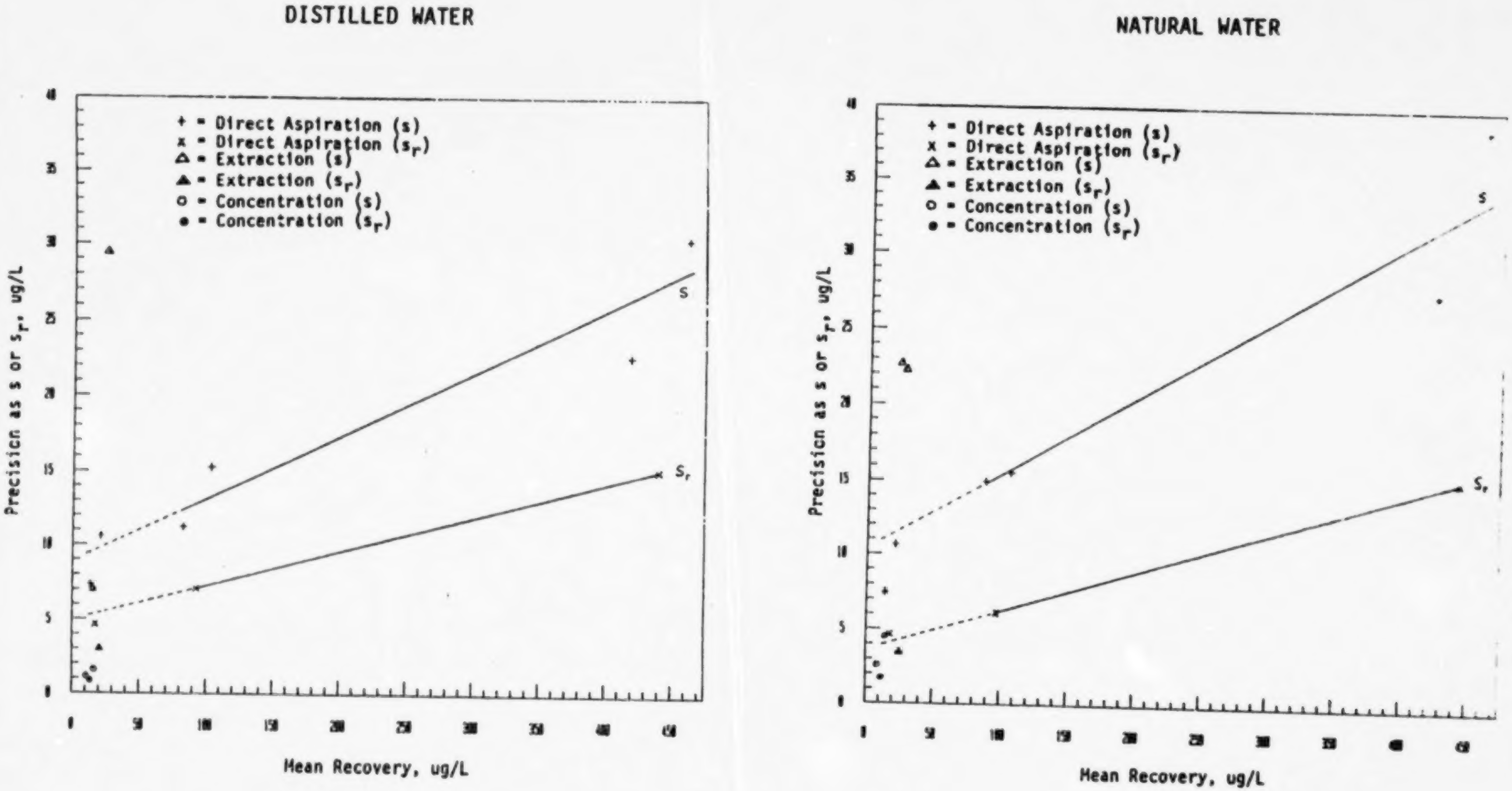
FIGURE 15: RECOVERY OF MANGANESE FROM DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

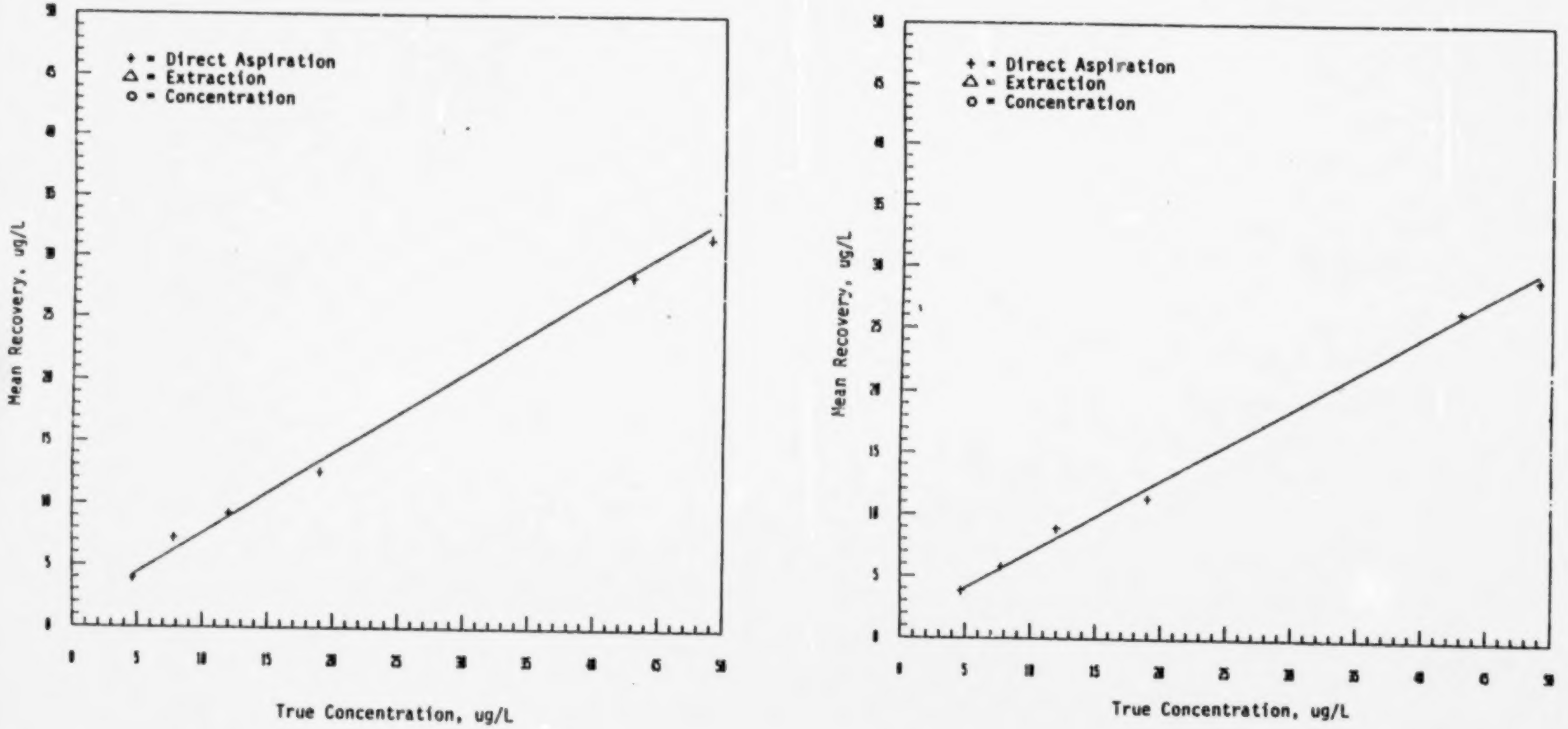
USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

FIGURE 16: PRECISION OF MANGANESE ANALYSES IN DISTILLED AND NATURAL WATER



USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

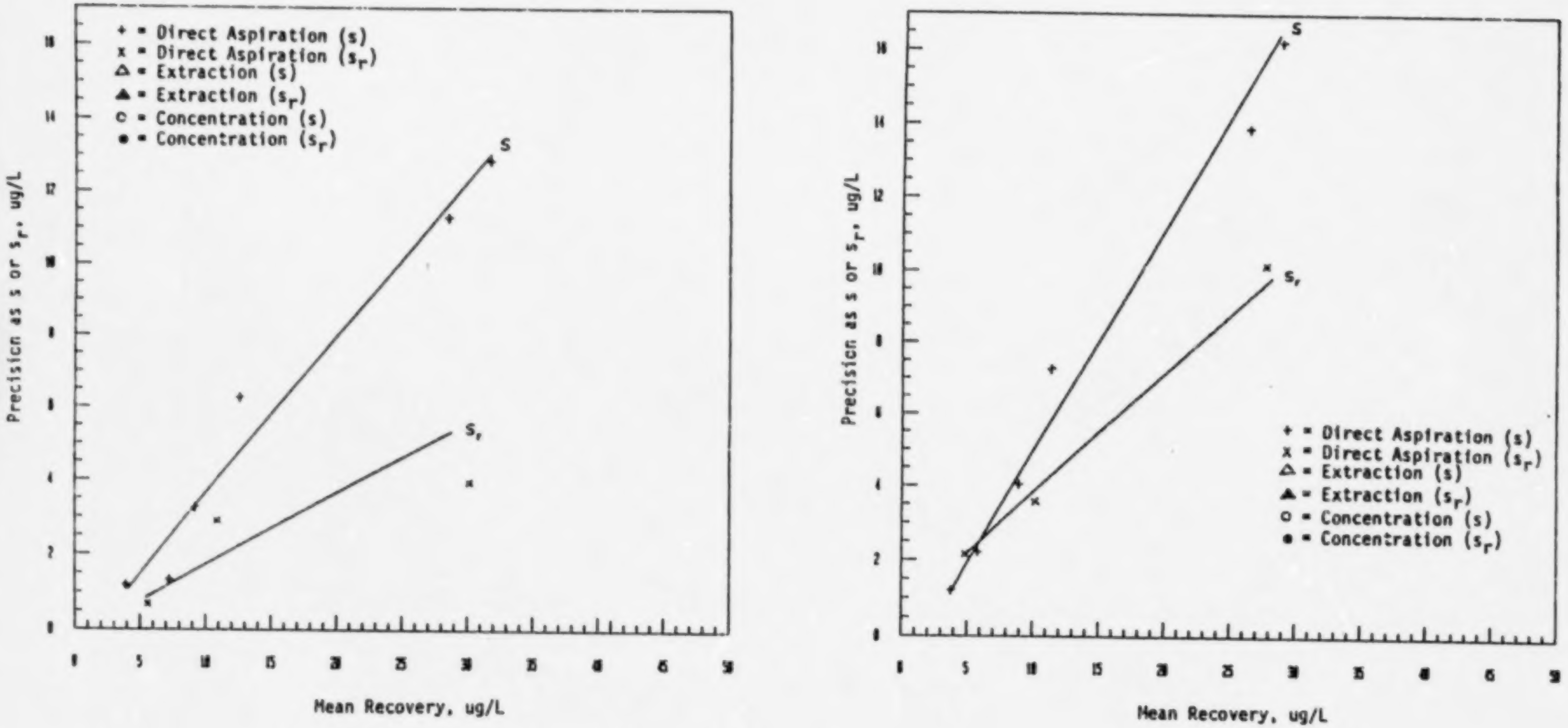
FIGURE 17: RECOVERY OF SELENIUM FROM DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

FIGURE 18: PRECISION OF SELENIUM ANALYSES IN DISTILLED AND NATURAL WATER

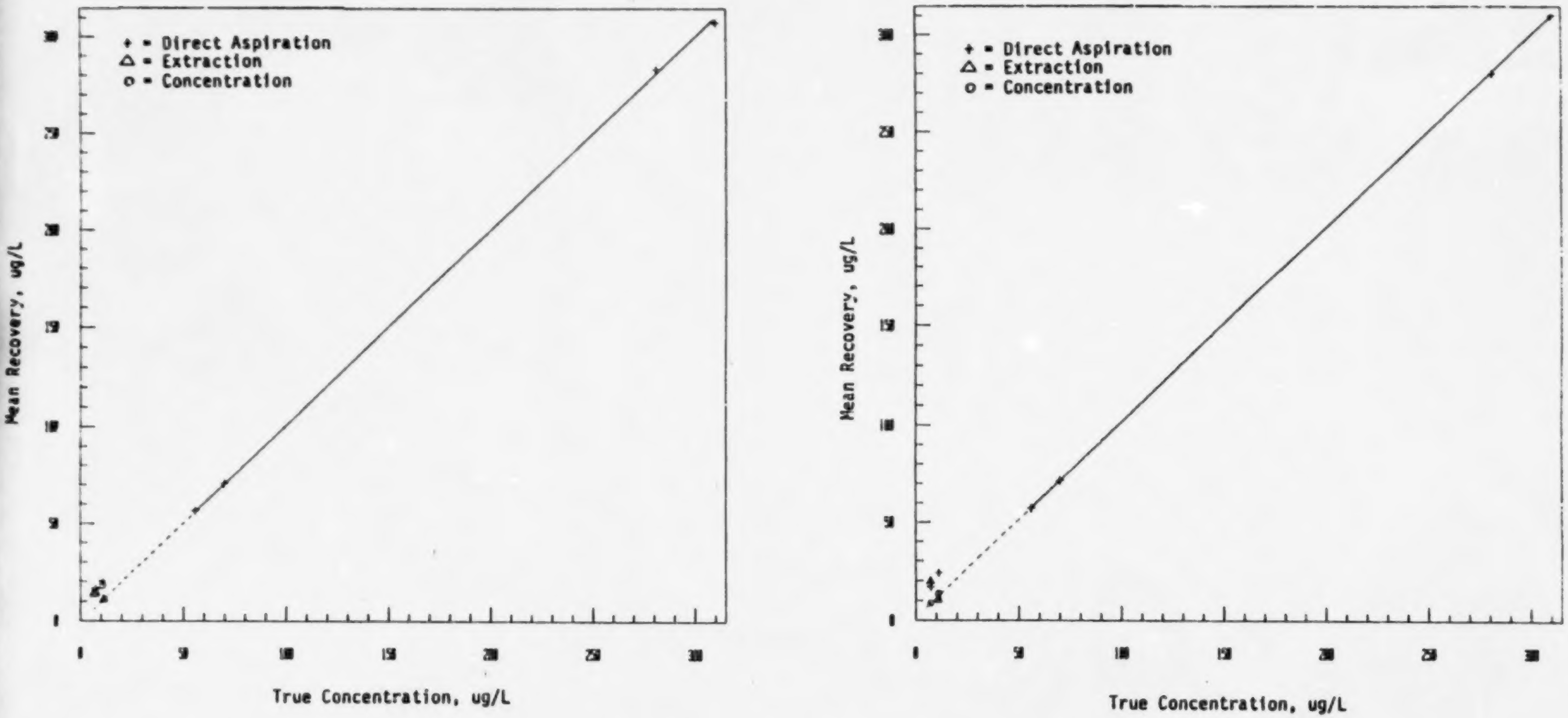


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

FIGURE 19: RECOVERY OF ZINC FROM DISTILLED AND NATURAL WATER

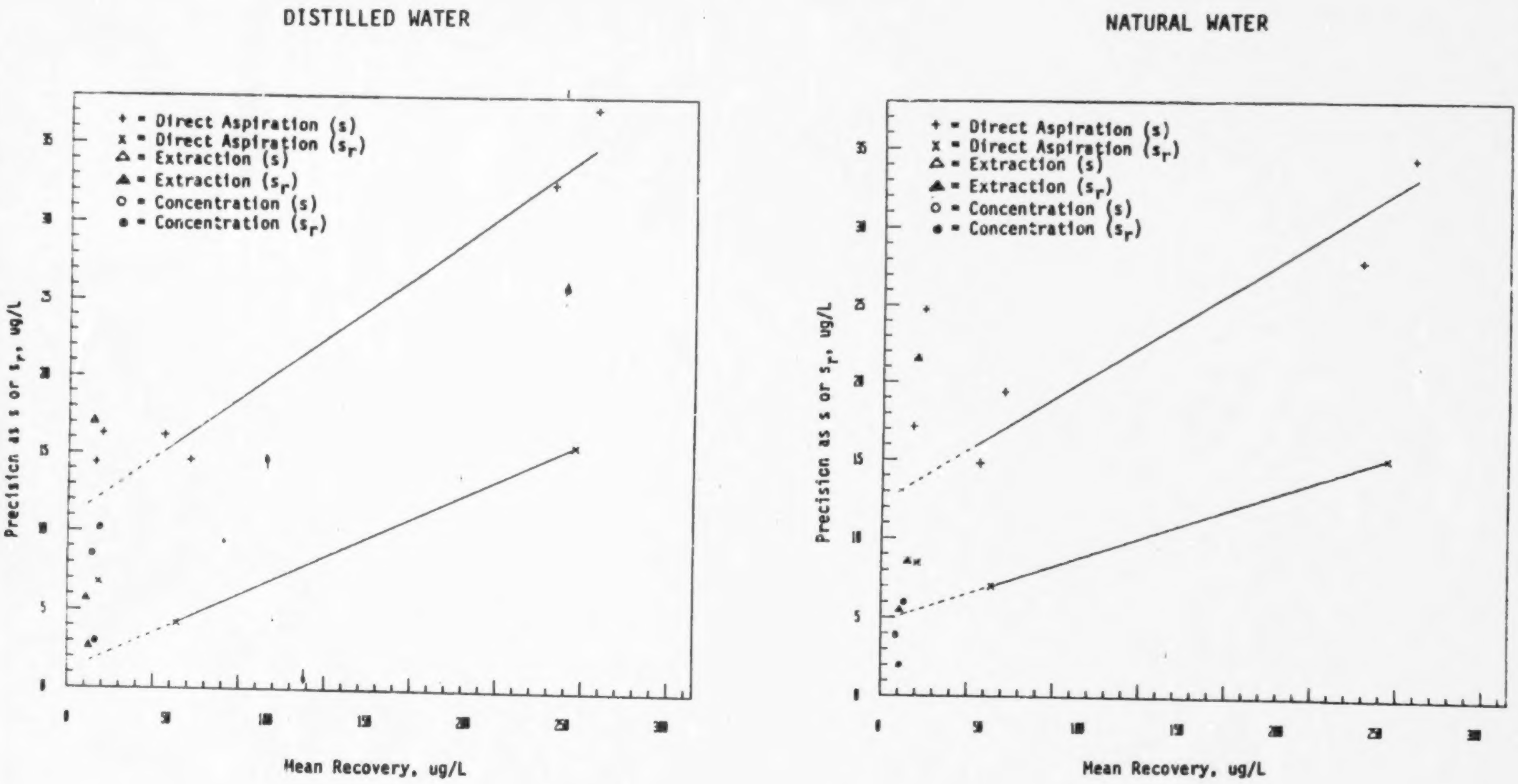


DISTILLED WATER

NATURAL WATER

USEPA METHOD STUDY 7, TRACE METALS IN WATER
BY AA SPECTROSCOPY (DIRECT ASPIRATION) AND COLORIMETRY

FIGURE 20: PRECISION OF ZINC ANALYSES IN DISTILLED AND NATURAL WATER


DISTILLED WATER

NATURAL WATER

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APPENDIX A

STUDY INSTRUCTIONS

ENVIRONMENTAL PROTECTION AGENCY
National Environmental Research Center
Method & Performance Evaluation
Analytical Quality Control Laboratory
Cincinnati, Ohio 45268

INSTRUCTIONS FOR *EPA Method Study 7, Trace Metals*

CAUTION: Read Instructions carefully before opening ampuls

The requested set of sample concentrates are enclosed. They were prepared by dissolving accurately-weighed amounts of spectrographically pure chemicals in distilled water for exact and preplanned concentrations. Each sample may be analyzed for Al, As, Cd, Cr, Cu, Fe, Mn, Pb, Se, and Zn. When diluted according to instructions, the concentrations of these metals are in the ranges found in clean and polluted streams. The samples have been analyzed repeatedly over a period of months to assure stability.

Please note that there are 6 ampuls in a set, with sets in duplicate if selenium analyses are done to insure enough sample volume for all analyses. Each is to be diluted and analyzed separately using the distilled water/natural water spike technique as follows:

> The concentrates from the ampuls are diluted to volume with distilled water and a river, lake, estuarine or salt water of the analyst's choice.
>
> The distilled water spike is analyzed directly. The natural water is analyzed with and without the spike and the spike's value determined by difference. Comparison of recoveries from distilled and natural waters distinguishes method bias and sample interferences.

The prepared samples are to be analyzed for the respective constituents using only the methods cited in the manual: *Methods for Chemical Analysis of Water and Wastes*, 1971, EPA. The necessary sections from this manual are enclosed. Since this study is intended to evaluate the performance of trained analysts, you are asked to analyze these samples only for those trace metals you regularly analyze.

The six ampuls cover three ranges of concentrations for each trace metal. Within a range, samples are paired, with each member of a pair being closely related in concentration to the other. The design is such that the maximum information can be gained without resorting to duplicate analyses. Only a single analysis should be made for each of the given parameters in each solution. However, multiple aspirations are acceptable to achieve a single answer as might be done with routine samples.

Remember that all standards should contain 0.15% reagent grade nitric acid (1.5 ml to 1 liter).

The metals in a sample may be below the limit of detection in aqueous solution. To determine these levels, the extraction procedure involving chelation with ammonium pyrrolidine dithiocarbamate and extraction with methyl isobutyl ketone should be used as described in: *Methods for Chemical Analysis of Water and Wastes*, 1971, EPA.

> Warning: When extraction techniques are used for chromium analyses, the oxidation step described in the enclosed methods must precede the extraction. The analyst should identify on the data report form all results obtained using extraction.

SAMPLE PREPARATION

> Note: Approximately 20 ml of concentrate is supplied in each ampul. With care and the use of clean, dry pipettes, the two ampuls provided are sufficient to do all determinations. You will need a one-liter volume of each sample for selenium analyses.

When ready to begin, open the ampul by snapping off the top at the narrow point on the neck and dilute as follows:

SAMPLE 1

Pipet 10.0 ml of concentrate 1, and 1.0 ml of reagent-grade nitric acid into a 1000 ml volumetric flask and make up to volume with distilled or natural water.

SAMPLE 2 and 3

Pipet 5.0 ml of concentrate and 1.5 ml of reagent grade nitric acid into a 1000 ml volumetric flask and make up to volume with distilled or natural water.

SAMPLE 4

Pipet 10.0 ml of concentrate and 1.0 ml of reagent grade nitric acid into a 1000 ml volumetric flask and make up to volume with distilled or natural water.

SAMPLE 5 and 6

Pipet 5.0 ml of concentrate and 1.5 ml of reagent grade nitric acid into a 1000 ml volumetric flask and make up to volume with distilled or natural water.

Report the results of each determination on the attached forms, entering your permanent laboratory code number and other information as requested. Note that separate columns are used for the distilled and natural water samples. Keep one copy of each form for your records. Report the number of significant figures given below:

Concentration of Element	No. of Significant Figures
1 - 99 μg/liter	2
100 - 999 μg/liter	3
≥1000 μg/liter	4

Please fill our the attached information form on the methods of analyses and instrumentation as fully as possible and return with data form.

The analyses should be completed and reported by October 30, 1972 to insure inclusion in the report. Return of data will be acknowledged promptly with a statement showing the true levels in the samples. If you have not already been assigned a laboratory code number, one will be assigned at that time. When all results have been received, the data will be evaluated statistically, and the findings released to all participating laboratories in a formal EPA report.

If there are any questions or problems concerning the study, please contact:

John A. Winter or Harold A. Clements
Method & Performance Evaluation, AQCL
National Environmental Research Center
1014 Broadway
Cincinnati, Ohio 45268

FTS: 513-684-2917
-2983

ENVIRONMENTAL PROTECTION AGENCY
Method & Performance Evaluation
Analytical Quality Control Laboratory
Cincinnati, Ohio 45268

EPA Method Study 7, Trace Metals

DATA REPORT FORM

Recovery of Metal, μg/l

Metal	Sample 1		Sample 2		Sample 3	
	In Distilled Water	In Natural Water	In Distilled Water	In Natural Water	In Distilled Water	In Natural Water
Al						
As						
Cd						
Cr						
Cu						
Fe						
Pb						
Mn						
Se						
Zn						

Please indicate samples extracted with an asterisk (*).

Natural Water Used (Type, Source, Location) ______________________________

____

Comments ______________________________________

____

____

Analyst ____________________ Date ____________________

Laboratory ____________________ Lab. Code ____________________

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Method & Performance Evaluation
Analytical Quality Control Laboratory
Cincinnati, Ohio 45268

EPA Method Study 7, Trace Metals

DATA REPORT FORM

Recovery of Metal, µg/l

	Sample 4		Sample 5		Sample 6	
Metal	In Distilled Water	In Natural Water	In Distilled Water	In Natural Water	In Distilled Water	In Natural Water
Al						
As						
Cd						
Cr						
Cu						
Fe						
Pb						
Mn						
Se						
Zn						

Please indicate samples extracted with an asterisk (*).

Natural Water Used (Type Source, Location) ________________________________

____

Comments ____

____

____

Analyst ______________________ Date ______________________

Laboratory ______________________ Lab. Code ______________________

ENVIRONMENTAL PROTECTION AGENCY
Method & Performance Evaluation
Analytical Quality ~~Control~~ Laboratory
Cincinnati, Ohio 45268

EPA Method Study 7, Trace Metals

DATA REPORT FORM

Recovery of Metal, µg/l

	Sample 1		Sample 2		Sample 3	
Metal	In Distilled Water	In Natural Water	In Distilled Water	In Natural Water	In Distilled Water	In Natural Water
Al						
As						
Cd						
Cr						
Cu						
Fe						
Pb						
Mn						
Se						
Zn						

Please indicate samples extracted with an asterisk (*).

Natural Water Used (Type, Source, Location) ______________________________

____

Comments ____

____

____

Analyst ________________________ Date ________________________

Laboratory ______________________ Lab. Code ____________________

ENVIRONMENTAL PROTECTION AGENCY
Method & Performance Evaluation
Analytical Quality Control Laboratory
Cincinnati, Ohio 45268

EPA Method Study 7, Trace Metals

DATA REPORT FORM

Recovery of Metal, μg/l

Metal	Sample 4		Sample 5		Sample 6	
	In Distilled Water	In Natural Water	In Distilled Water	In Natural Water	In Distilled Water	In Natural Water
Al						
As						
Cd						
Cr						
Cu						
Fe						
Pb						
Mn						
Se						
Zn						

Please indicate samples extracted with an asterisk (*).

Natural Water Used (Type Source, Location) ______________________

Comments ______________________

Analyst ______________________ Date ______________________

Laboratory ______________________ Lab. Code ______________________

ENVIRONMENTAL PROTECTION AGENCY
National Environmental Research Center
Method & Performance Evaluation
Analytical Quality Control Laboratory
Cincinnati, Ohio 45268

EPA Method Study 7, Trace Metals

Atomic Absorption Spectrophotometer Information

Manufacturer: ______________________________

Model: ______________________________

Special Features:

Readout Means: % Transmittance/Absorbance Meter ______________

Digital Display __________ Paper Printer ______________

Recorder Plot __________ Other ______________

____

Remarks: ______________________________

____

____

Laboratory ______________________ Lab. Code ____

Trace Metals Analyses by Atomic Absorption

From: *Methods for Chemical Analysis of Water and Wastes*, 1971, EPA, NERC, AQCL.

METALS

(Atomic Absorption Methods)

1. Scope and Application

   1.1 Metals in solution may be readily determined by atomic absorption spectroscopy. The method is simple, rapid, and applicable to a large number of metals in surface waters, domestic and industrial wastes, and saline waters.

   1.2 Detection limits, sensitivity and optimum ranges of the metals will vary with the various makes and models of satisfactory atomic absorption spectrophotometers. The data shown in Table 1, however, provide some indication of the concentration ranges measurable. In the majority of instances the concentration range shown in the table may be extended much lower with scale expansion and conversely extended upwards by using a less sensitive wavelength. Detection limits may also be extended through concentration of the sample or through solvent extraction techniques. Table 1 lists detection limits, sensitivities, and the optimum concentration ranges achieved directly on the sample using the Instrumentation Laboratories, Model IL-153 without scale expansion (Pos 2.5). The boat technique developed at Perkin-Elmer for use with the PE303 or 403 may also be used to extend absolute detection limits.(1)

TABLE 1

Concentration Ranges

Metal	Detection Limit mg/l	Sensitivity mg/l	Optimum Concentration Range mg/l
Aluminum	0.1	0.4	10 - 1000
Arsenic	0.05	1.0	10 - 100
Cadmium	0.001	0.004	0.1 - 2
Calcium	0.003	0.07	1 - 200
Chromium	0.01	0.02	1 - 200
Copper	0.005	0.04	0.1 - 10
Iron	0.004	0.006	0.1 - 20
Lead	0.01	0.06	1 - 10
Magnesium	0.0005	0.005	0.01 - 2
Manganese	0.005	0.04	0.1 - 20
Potassium	0.005	0.01	0.01 - 2
Silver	0.01	0.05	0.1 - 20
Sodium	0.001	0.003	1 - 200
Zinc	0.005	0.02	0.1 - 2

2. Summary of Method

2.1 Atomic absorption spectroscopy is similar to flame emission photometry in that a sample is atomized and aspirated into a flame. Flame photometry, however, measures the amount of light emitted, whereas, in atomic absorption spectrophotometry a light beam is directed through the flame into a monochromator, and onto a detector that measures the amount of light absorbed. In many instances absorption is more sensitive because it depends upon the presence of free unexcited atoms and generally the ratio of unexcited to excited atoms at a given moment is very high. Since the wavelength of the light beam is characteristic of only the metal being determined, the light energy absorbed by the flame is a measure of the concentration of that metal in the sample. This principle is the basis of atomic absorption spectroscopy.

2.2 Although methods have been reported for the analysis of solids by atomic absorption spectroscopy(2) the technique generally is limited to metals in solution or solubilized through some form of sample processing. Thus, it is a relatively simple matter to determine metals in the dissolved fraction by aspirating a filtered portion of the water sample.

2.2.1 In those instances where complete characterization of a sample is desired, the suspended material must also be analyzed. This may be accomplished by filtration and acid digestion of the suspended material. Metallic constituents in this acid digest are subsequently determined and the sum of the dissolved plus suspended concentrations will then provide the total concentrations present.

2.2.2 The sample may also be treated with acid before filtration to measure what may be termed "extractable" concentrations.

3. Definition of Terms

3.1 Sensitivity: is the concentration in milligrams of metal per liter that produces an absorption of 1%.

3.2 Detection Limit: is defined as the concentration that produces absorption equivalent to twice the magnitude of the fluctuation in the background (zero absorption).

3.3 Dissolved Metals: those constituents (metals) which will pass through a 0.45 μ membrane filter.

3.4 Suspended Metals: those constituents (metals) which are retained by a 0.45 μ membrane filter.

3.5 Total Metals: the concentration of metals determined on an unfiltered sample following vigorous digestion (Section 4.1.3), or the sum of the concentrations of metals in both the dissolved and suspended fractions.

3.6 Extractable Metals: the concentration of metals in an unfiltered sample following digestion with hot dilute mineral acid (Section 4.1.4).

4. Sample Handling and Preservation

4.1 For the determination of trace metals, contamination and loss are of prime concern. Dust in the laboratory environment, impurities in reagents and impurities on laboratory apparatus which the sample contacts are all sources of potential contamination. For liquid samples, containers can introduce either positive or negative errors in the measurement of trace metals by (a) contributing contaminants through leaching or surface desorption and (b) by depleting concentrations through adsorption. Thus the collection and treatment of the sample prior to analysis requires particular attention. The sample bottle should be thoroughly washed with detergent and tap water; rinsed with chromic acid, tap water, 1:1 nitric acid, tap water and finally distilled water in that order. Before collection of the sample a decision must be made as to the type of data desired, i.e., dissolved, suspended, total or extractable.

4.1.1 For the determination of dissolved constituents the sample should be filtered through a 0.45 μ membrane filter as soon as practicable after collection. Use the first 50-100 ml to rinse the filter flask. Discard this portion and collect the required volume of filtrate. Acidify the filtrate with 1:1 redistilled HNO_3 (3 ml per liter). Normally this amount of acid will lower the pH to 2 or 3 and should be sufficient to preserve the sample indefinitely. (See Note 1). Analyses performed on a sample so treated shall be reported as "dissolved" concentrations.

NOTE 1: It has been suggested (International Biological Program, Symposium on Analytical Methods, Amsterdam, Oct. 1966) that additional acid, as much as 25 ml of concentrated HCl/liter may be required to stabilize certain types of highly buffered samples if they are to be stored for any length of time. Therefore, special precautions should be observed for preservation and storage of unusual samples intended for trace metal analysis.

4.1.2 For the determination of suspended metals a representative volume of sample should be filtered through a 0.45 μ membrane filter. When considerable sediment is present, as little as 100 ml of a well shaken sample is filtered.

Record the volume filtered and transfer the membrane filter containing the sediment to a 250 ml Griffin beaker and add 3 ml distilled HNO_3. Cover the beaker with a watch glass and heat gently. The warm acid will soon dissolve the membrane. Increase the temperature of the hot-plate and digest the material. When the acid has evaporated, cool the beaker and watch glass and add another 3 ml of distilled HNO_3.

Cover and continue heating until the digestion is complete, generally indicated by a light colored residue. Add distilled 1:1 HCl (2 ml) to the dry residue and again warm the beaker gently to dissolve the material. Wash down the watch glass and beaker walls with distilled water and filter the sample to remove silicates and other insoluble material that could clog the atomizer. Adjust the volume to some predetermined value based on the expected concentrations of trace metals present. This volume will vary depending on the metal to be determined. The sample is now ready for analysis. Concentrations so determined shall be reported as "suspended". STORET parameter numbers for reporting this type of data are currently being assigned.

4.1.3 For the determination of total metals the sample is not filtered before processing. Choose a volume of sample appropriate for the expected level of metals. If much suspended material is present, as little as 50-100 ml of well mixed sample will most probably be sufficient. (The sample volume required may also vary proportionally with the number of metals to be determined).

Transfer a representative aliquot of the well mixed sample to a Griffin beaker and add 3 ml of concentrated distilled HNO_3. Place the beaker on a hot plate and evaporate to dryness making certain that the sample does not boil. Cool the beaker and add another 3 ml portion of distilled concentrated HNO_3. Cover the beaker with a watch glass and return to the hot plate. Increase the temperature of the hot plate so that a gentle reflux action occurs. Continue heating, adding additional acid as necessary until the digestion is complete, generally indicated by a light colored residue. Add sufficient distilled 1:1 HCl and again warm the beaker to dissolve the residue. Wash down the beaker walls and watch glass with distilled water and filter the sample to remove silicates and other insoluble material that could clog the atomizer. Adjust the volume to some predetermined value based on the expected metal concentrations. The sample is now ready for analysis. Concentrations so determined shall be reported as "total". STORET parameter numbers for reporting this type of data have been assigned and are given for each metal.

4.1.4 To determine metals soluble in diluted hot HCl - HNO_3, acidify the entire sample at the time of collection with redistilled HNO_3, 5 ml/l. At the time of analysis the sample is mixed and a 100-ml aliquot transferred to a beaker or flask. Five ml of redistilled hydrochloric acid is added and the sample heated for 15 minutes on a steam bath or hot plate. After this digestion period the sample is filtered and the volume adjusted to 100 ml. The sample is then ready for analysis.

The data so obtained are significant in terms of "total" metals in the sample, with the reservation that something less than "total" is actually measured. Concentrations of metal found, especially in heavily silted samples, will be substantially higher than data obtained on only the soluble fraction. STORET parameter numbers for the storage of this type data are not available at this time.

5. Interferences

5.1 The most troublesome type of interference in atomic absorption spectrophotometry is usually termed "chemical" and is caused by lack of absorption of atoms bound in molecular combination in the flame. This phenomenon can occur when the flame is not sufficiently hot to dissociate the molecule, as in the case of phosphate interference with magnesium, or because the dissociated atom is immediately oxidized to a compound that will not dissociate further at the temperature of the flame. The addition of lanthanum will overcome the phosphate interference in the magnesium determination. Similarly, silica interference in the determination of manganese can be eliminated by the addition of calcium.

5.1.1 Chemical interferences may also be eliminated by separating the metal from the interfering material. While complexing agents are usually employed to increase the sensitivity of the analysis they may also be used to eliminate or reduce interferences.

6. Apparatus

6.1 Atomic absorption spectrophotometer: Any commercial atomic absorption instrument having an energy source, an atomizer burner system, a monochromater, and a detector is suitable.

6.2 Burner: A Boling burner is recommended for most aqueous solutions. A premix burner is used for organic solvents. For certain elements the nitrous oxide burner is required.

6.3 Volumetric flasks: 200 ml, for extraction with organic solvents.

6.4 Glassware: All glassware, including sample bottles, should be washed with detergent, rinsed with tap water, chromic acid, tap water, 1:1 nitric acid, tap water and distilled water in that order.

6.5 Borosilicate glass distillation apparatus.

7. Reagents

7.1 Deionized distilled water: Prepare by passing distilled water through a mixed bed of cation and anion exchange resins. Use deionized distilled water for the preparation of all reagents, calibration standards, and as dilution water.

7.2 Nitric acid (conc): Distill reagent grade nitric acid in a borosilicate glass distillation apparatus. Prepare a 1:1 dilution with deionized distilled water. Caution: Distillation should be performed in hood with protective sash in place.

7.3 Hydrochloric acid (1:1): Prepare a 1:1 solution of reagent grade hydrochloric acid and distilled water. Distill this mixture from a borosilicate glass distillation apparatus.

7.4 Stock metal solutions: Prepare as directed in 8.1 and under the individual metal procedures.

7.5 Standard metal solutions: Prepare a series of standards of the metal by dilution of the appropriate stock metal solution to cover the concentration range desired.

7.6 Fuel and oxidant: Commercial grade acetylene is generally acceptable. Air may be supplied from a compressed air line, a laboratory compressor, or from a cylinder of compressed air. Reagent grade nitrous oxide is also required for certain determinations.

7.7 Special reagents for the extraction procedure.

7.7.1 Ammonium pyrrolidine dithiocarbamate solution (APDC): Dissolve 1 g APDC in 100 ml of deionized distilled water. Prepare fresh before use.

7.7.2 Hydrochloric acid, 0.3N: Mix 25 ml conc. HCl with deionized distilled water and dilute to 1 liter.

Ammonium pyrrolidine dithiocarbamate (APDC) may be obtained commercially from Fisher Scientific Company (Cat. No. A-182), K and K Labs., Inc., or Eastman Kodak.

7.7.3 Methyl isobutyl ketone (MIBK): (see Note 2)

NOTE 2: One objection to MIBK is the increased solubility in a highly acid medium. By using a 3:1 mixture of MIBK - cyclohexane the solubility in the aqueous phase is decreased without any significant change in the extraction of the various chelates or burning characteristics of the ketone. Ethyl propionate has also been found to be a suitable solvent. Benzene and kerosene are inferior to MIBK because they produce a large luminous and smoke flame. Carbon tetrachloride or chloroform may also be used; however, the enhancement is considerable less than with MIBK.

7.7.4 Sodium hydroxide, 2.5N: Dissolve 10 g NaOH in deionized distilled water and dilute to 100 ml.

8. Preparation of Standards and Calibration

8.1 Stock solutions are prepared from high purity metals, oxides or nonhygroscopic reagent grade salts using redistilled nitric or hydrochloric acids. Sulfuric or phosphoric acids should be avoided as they produce an adverse effect on many elements. The stock solutions are prepared at concentrations of 1000 mg of the metal per liter.

8.2 Standard solutions are prepared by diluting the stock metal solutions at the time of analysis. For best results, calibration standards should be prepared fresh each time an analysis is to be made and discarded after use. Prepare a blank and calibration standards in graduated amounts in the appropriate range. As the filtered samples are preserved with redistilled nitric acid (3 ml 1:1 per liter) the acid strength of the calibration standards should be similarly adjusted. Beginning with the blank and working toward the highest standard, aspirate the solutions and record the readings. Repeat the operation with both the calibration standards and the samples a sufficient number of times to secure a reliable average reading for each solution.

8.3 For those instruments which do not read out directly in concentration a calibration curve is prepared to cover the appropriate concentration range. Usually, this means the preparation of standards which produce an absorption of 0 to 80 percent. The correct method for plotting data derived from an atomic absorption instrument equipped with a linear readout system is to convert percent absorption to absorbance and plot the absorbance against concentration. The following relationship is used to convert absorption values to absorbance:

$$\text{absorbance} = \log (100/\%\ T) = 2 - \log \%\ T$$

$$\text{where } \%\ T = 100 - \%\ \text{absorption}$$

As the curves are frequently nonlinear, especially at high absorption values, the number of standards should be increased in that portion of the curve.

9. General Procedure for Analysis by Atomic Absorption

9.1 Differences between the models of satisfactory atomic absorption spectrophotometers prevent the formulation of detailed instructions applicable to every instrument. The analyst should follow the manufacturer's operating instructions for his particular instrument. In general, after choosing the correct hollow cathode lamp for the analysis, the lamp should be allowed to warm up for a minimum of 15 minutes. During this period, align the instrument, position the monochromator at the correct wavelength, select the proper monochromator slit width, adjust the hollow cathode current according to the manufacturer's recommendation, light the flame and regulate the flow of fuel and oxidant, adjust the burner for maximum percent absorption and stability and balance the photometer. Run a series of standards of the element under analysis and construct working curves by plotting the concentrations of the standards against the absorbance. For those instruments which read directly in concentration set the curve corrector to read out the proper concentration. Aspirate the samples and determine the concentrations either directly or from the calibration curve. For best results run standards each time a sample or series of samples are run.

9.2 Special Extraction Procedure: When the concentration of the metal is not sufficiently high to determine directly, or when considerable dissolved solids are present in the sample, certain of the metals may be chelated and extracted with organic solvents. Ammonium pyrrolidine dithiocarbamate (APDC) is widely used for this purpose and is particularly useful for zinc, cadmium, iron, manganese, copper, silver, lead and chromium^{+6}. Tri-valent chromium does not react with APDC unless it has first been converted to the hexavalent form[3]. Aluminum, beryllium, barium and strontium also do not react with APDC.

The most frequently used organic solvent for APDC is methyl isobutyl ketone (MIBK). Apart from the fact that the solvent should extract the chelate, it should burn and provide a stable flame. In addition, the physical properties of the solvent such as viscosity, surface tension, boiling point, and mutual solubility in an aqueous medium must be taken into account. It should not produce toxic products during combustion or give a high background in the flame (see Note 3).

NOTE 3: The methods described herein have been found to be satisfactory for natural and fresh water types of samples when used by a qualified analyst. Occasions have been reported when other types of samples (sea water, brine, etc.) have presented some problems with the extraction procedure. Therefore, users are cautioned to confirm their suitability through application on spiked samples.

9.2.1 Extraction Procedure with APDC: The following extraction procedure is a general one which may be used for the majority of metals. Manganese, however, will not be extracted unless the pH is adjusted to between 4.5 and 5.0. In addition, the manganese complex is extremely unstable and must be analyzed without delay.

a. Transfer a volume of sample (100 ml maximum) into a 250 ml Griffin beaker and adjust the volume to 100 ml with deionized distilled water.

b. Prepare a blank and sufficient standards in the same manner and adjust the volume of each to approximately 100 ml with deionized distilled water.

c. Adjust the pH of the samples and standards to a pH of 2.5 using a pH meter.

d. Transfer the samples and standards to a 200 ml volumetric flask and add 2.5 ml fresh APDC solution and mix.

e. Add 10.0 ml MIBK and shake vigorously for one minute.

f. Allow the layers to separate and add deionized distilled water until the ketone layer is completely in the neck of the flask. Centrifuge if separation is not complete.

g. Aspirate the ketone layer and record the scale readings for each standard and sample against the prepared blank. Repeat and average the duplicate results. Plot a calibration curve in μg metal vs. absorbance (see Note 4).

NOTE 4: When aspirating organic solvents the fuel-to-air ratio should be reduced as the burning of the organic solvent contributes to the fuel supply. When adjusting the fuel-to-air ratio of the gas mixture at the burner, begin with the settings recommended by the manufacturer. Gradually reduce the fuel flow while the organic solvent is being aspirated until the flame is as blue as possible. Care should be taken that the flame does not lift off the burner producing an undesirable luminescent flame.

10. Calculation

10.1 Direct determination: Read the metal value in mg/l from the calibration curve or directly from the readout system of the instrument.

mg/l metal in sample = (mg/l of metal in the aliquot) x D

$$\text{where } D = \frac{\text{ml of aliquot + ml of deionized distilled water}}{\text{ml of aliquot}}$$

10.2 Extracted samples: Read the metal value in µg from the extracted calibration curve or from the readout system of the instrument.

$$\text{mg/l metal in sample} = \frac{\mu\text{g metal in aliquot}}{\text{ml of aliquot}}$$

11. Precision and Accuracy

11.1 Three synthetic unknown samples containing varying concentrations of cadmium, chromium, copper, iron, lead, magnesium, manganese, silver, and zinc were analyzed in 59 laboratories with the results indicated in Table 2. (Analytical Reference Service PHS).

Table 2

Precision and Accuracy Data for Atomic Absorption Methods

Metal	Metal Concentration, µg/l	Relative Error, percent	Relative Standard Deviation, percent
Direct determination			
Cadmium	50	8.15	21.62
Chromium	50	2.29	26.44
Copper	1000	3.42	11.23
Iron	300	0.64	16.53
Magnesium	200	6.30	10.49
Manganese	50	6.00	13.50
Silver	50	10.57	17.47
Zinc	500	0.41	8.15
Extracted samples			
Cadmium	10	3.03	72.77
Lead	50	19.00	23.46

References:

(1) Atomic Absorption Newsletter, 7, 35 (1968).
(2) Spectrochim Acta, 24B, 53 (1969).
(3) Atomic Absorption Newsletter, 6, 128 (1967).

ALUMINUM

(Standard Conditions)

STORET NO:
DISSOLVED: 01105
TOTAL : 01106

Optimum Concentration Range 10-1000 mg/l using the 3092 A line

Sensitivity 0.4 mg/l

Detection Limit 0.1 mg/l

Preparation of Standard Solution

1. Stock Solution: Carefully weigh 1.000 gram of aluminum metal (analytical reagent grade). Add 15 ml of concentrated HCl to the metal in a covered beaker and warm gently. When solution is complete, transfer quantitatively to 1 liter volumetric flask and make up to volume with distilled water. One ml equals 1 mg Al.
2. Prepare dilutions of the stock solution to be used as calibration standards at the time of analysis. Maintain an acid strength of 0.15% nitric acid in all calibration standards.

Instrumental Parameters (General)

1. Aluminum hollow cathode lamp
2. Wavelength: 3092 A
3. Type of burner: Nitrous oxide
4. Fuel: Acetylene
5. Oxidant: Nitrous oxide
6. Type of flame; Fuel rich
7. Photomultiplier tube: IP-28

Notes

1. The following lines may also be used:

   3082 A Relative Sensitivity 1

   3962 A Relative Sensitivity 2

   3944 A Relative Sensitivity 2.5

CADMIUM

(Standard Conditions)

STORET NO:
DISSOLVED: 01025
TOTAL : 01027

Optimum Concentration Range 0.1-1 mg/l using the 2288 A line

Sensitivity 0.004 mg/l

Detection Limit 0.001 mg/l

Preparation of Standard Solution

1. Stock Solution: Carefully weigh 1.142 grams of cadmium oxide (CdO, analytical reagent grade) and dissolve in 5 ml redistilled HNO_3. Dilute to 1 liter with distilled water. One ml equals 1 mg Cd.
2. Prepare dilutions of the stock solution to be used as calibration standards at the time of analysis. Maintain an acid strength of 0.15% nitric acid in all calibration standards.

Instrumental Parameters (General)

1. Cadmium hollow cathode lamp
2. Wavelength: 2288 A
3. Type of burner: Boling
4. Fuel: Acetylene
5. Oxidant: Air
6. Type of flame: Oxidizing
7. Photomultiplier tube: IP-28

CHROMIUM

(Standard Conditions)

STORET NO:
DISSOLVED: 01030
TOTAL : 01034

Optimum Concentration Range 1.0-200 mg/l using the 3579 A line

Sensitivity 0.02 mg/l

Detection Limit 0.01 mg/l

Preparation of Standard Solution

1. Stock Solution: Dissolve 1.923 gram of chromium trioxide (CrO_3, reagent grade) in distilled water. When solution is complete, acidify with redistilled HNO_3 and dilute to 1 liter with distilled water. One ml equals 1 mg chromium.
2. Prepare dilutions of the stock solution to be used as calibration standards at the time of analysis. Maintain an acid strength of 0.15% nitric acid in all calibration standards.

Instrumental Parameters (General)

1. Chromium hollow cathode lamp
2. Wavelength: 3579 A
3. Type of burner: Boling
4. Fuel: Acetylene
5. Oxidant: Air
6. Type of flame: Slightly fuel rich
7. Photomultiplier tube: IP-28

Notes

1. The following wavelengths may also be used:

   3605 A Relative Sensitivity 1.2
   3593 A Relative Sensitivity 1.4
   4254 A Relative Sensitivity 2
   4274 A Relative Sensitivity 3
   4289 A Relative Sensitivity 4

2. The determination of chromium requires a rich acetylene flame. The absorption is very sensitive to the fuel-to-air ratio.
3. The absorption of chromium is suppressed by iron and nickel. If the analysis is performed in a lean flame the interference can be lessened but the sensitivity will also be reduced. The interference does not exist in a nitrous oxide - acetylene flame.
4. For low levels of chromium the extraction procedure (MIBK-APDC) is recommended. Only hexavalent chromium will react with APDC, thus, to measure trivalent chromium an oxidation step must be included.

   See accompanying instructions for *Chelation-Extraction Techniques for Chromium.* Brown, E., Skougstad, M. W., and Fishman, M. J. Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases, Book 5, Chapter A1, 1970, U. S. Geological Survey, Denver, Colorado.

COPPER

(Standard Conditions)

STORET NO:
DISSOLVED: 01040
TOTAL : 01042

Optimum Concentration Range 0.1-10 mg/l using the 3247 A line

Sensitivity 0.04 mg/l

Detection Limit 0.005 mg/l

Preparation of Standard Solution

1. Stock Solution: Carefully weigh 1.00 gram of electrolytic copper (analytical reagent grade). Dissolve in 5 ml redistilled HNO_3 and make up to 1 liter with distilled water. Final concentration is 1 mg Cu per ml (1000 mg/l).
2. Prepare dilutions of the stock solution to be used as calibration standards at the time of analysis. Maintain an acid strength of 0.15% nitric acid in all calibration standards.

Instrumental Parameters (General)

1. Copper hollow cathode lamp
2. Wavelength: 3247 A
3. Type of burner: Boling
4. Fuel: Acetylene
5. Oxidant: Air
6. Type of flame: Oxidizing
7. Photomultiplier tube: IP-28

Notes

1. For copper concentrations below 0.05 mg/l, the extraction procedure is suggested.
2. Copper atoms are distributed over a wider area in laminar flow-flames than that normally found. Consequently, the burner parameters are not as critical as for most other elemental determinations.

3. Because of the spectral intensity of the 3247 A line, the P.M. tube may become saturated. If this situation occurs the current should be decreased.

4. Numerous absorption lines are available for the determination of copper. By selecting a suitable absorption wavelength, copper samples may be analyzed over a very wide range of concentration. The following lines may be used:

   3264 A Relative Sensitivity 2

   2178 A Relative Sensitivity 4

   2165 A Relative Sensitivity 7

   2181 A Relative Sensitivity 9

   2225 A Relative Sensitivity 20

   2024 A Relative Sensitivity 20

   2492 A Relative Sensitivity 90

IRON

(Standard Conditions)

STORET NO:
DISSOLVED: 01046
TOTAL : 01045

Optimum Concentration Range 0.1-20 mg/l using the 2483 A line

Sensitivity 0.006 mg/l

Detection Limit 0.004 mg/l

Preparation of Standard Solution

1. Stock Solution: Carefully weigh 1.000 gram of pure iron wire (analytical reagent grade) and dissolve in 5 ml redistilled HNO_3, warming if necessary. When solution is complete make up to 1 liter with distilled water. One ml equals 1 mg Fe (1000 mg/l).
2. Prepare dilutions of the stock solutions to be used as calibration standards at the time of analysis. Maintain an acid strength of 0.15% nitric acid in all calibration standards.

Instrumental Parameters (General)

1. Iron hollow cathode lamp
2. Wavelength: 2483 A
3. Type of burner: Boling
4. Fuel: Acetylene
5. Oxidant: Air
6. Type of flame: Oxidizing
7. Photomultiplier tube: IP-28

Notes

1. The following lines may also be used:

   2488 A Relative Sensitivity 2

   2522 A Relative Sensitivity 2

   2719 A Relative Sensitivity 4

   3021 A Relative Sensitivity 5

2527 A Relative Sensitivity 6

2721 A Relative Sensitivity 9

3720 A Relative Sensitivity 10

2967 A Relative Sensitivity 12

3860 A Relative Sensitivity 20

3441 A Relative Sensitivity 30

2. Absorption is strongly dependent upon the lamp current.
3. Better signal-to-noise can be obtained from a neon-filled hollow cathode lamp than from an argon-filled lamp.

LEAD

(Standard Conditions)

STORET NO:
DISSOLVED: 01049
TOTAL : 01051

Optimum Concentration Range 1-10 mg/l using the 2170 A line

Sensitivity 0.06 mg/l

Detection Limit 0.01 mg/l

Preparation of Standard Solution

1. Stock Solution: Carefully weigh 1.599 gram of analytical reagent grade lead nitrate [$Pb(NO_3)_2$,] and dissolve in redistilled water. When solution is complete acidify with 10 ml redistilled HNO_3 and dilute to 1 liter with distilled water. One ml equals 1 mg Pb (1000 mg/l).
2. Prepare dilutions of the stock solution to be used as calibration standards at the time of analysis. Maintain an acid strength of 0.15% nitric acid in all calibration standards.

Instrumental Parameters (General)

1. Lead hollow cathode lamp
2. Wavelength: 2170
3. Type of burner: Boling
4. Fuel: Acetylene
5. Oxidant: Air
6. Type of flame: Slightly oxidizing
7. Photomultiplier tube: IP-28

Notes

1. The analysis of this metal is exceptionally sensitive to turbulence and absorption bands in the flame. Therefore, some care should be taken to position the light beam in the most stable, center portion of

the flame. To do this, first adjust the burner to maximize the absorbance reading with a lead standard. Then, aspirate a water blank and make minute adjustments in the burner alignment to minimize the signal.

2. Better analytical results with the 2170 A line may be obtained by using a R-106 photomultiplier tube which is more sensitive to UV light.
3. For lead concentrations below 0.2 mg/1, the extraction procedure is suggested. The optimum pH for the extraction is 2.8.
4. The following lines may also be used:

2833 A	Relative Sensitivity	2
2614 A	Relative Sensitivity	500
3683 A	Relative Sensitivity	900

MANGANESE

(Standard Conditions)

STORET NO:
DISSOLVED: 01056
TOTAL : 01055

Optimum Concentration Range 0.1-20 mg/1 using the 2795 A line

Sensitivity 0.04 mg/1

Detection Limit 0.005 mg/1

Preparation of Standard Solution

1. Stock Solution: Carefully weigh 1.583 gram of analytical reagent grade manganese dioxide, MnO_2 and dissolve in 10 ml of HCl. When solution is complete dilute to 1 liter with distilled water. One ml equals 1 mg Mn (1000 mg/1).
2. Prepare dilutions of the stock solution to be used as calibration standards at the time of analysis. Maintain an acid strength of 0.15% nitric acid in all calibration standards.

Instrumental Parameters (General)

1. Manganese hollow cathode lamp
2. Wavelength: 2795 A
3. Type of burner: Boling
4. Fuel: Acetylene
5. Oxidant: Air
6. Type of flame: Oxidizing
7. Photomultiplier tube: IP-28

Notes

1. For manganese concentrations below 0.01 mg/1, the extraction procedure is suggested. The extraction is carried out at pH 4.5-5. The manganese chelate is very unstable and the analysis must be made without delay to prevent its re-solution in the aqueous phase.
2. Analytical sensitivity is somewhat dependent on lamp current.

ZINC

(Standard Conditions)

STORET NO:
DISSOLVED: 01090
TOTAL : 01092

Optimum Concentration Range 0.1-2 mg/l using the 2139 A line

Sensitivity 0.02 mg/l

Detection Limit 0.005 mg/l

Preparation of Standard Solution

1. Stock Solution: Carefully weigh 1.00 gram of analytical reagent grade zinc metal and dissolve cautiously in 10 ml HNO_3. When solution is complete make up to 1 liter with distilled water. One ml equals 1 mg Zn (1000 mg/l).
2. Prepare dilutions of the stock solution to be used as calibration standards at the time of analysis. Maintain an acid strength of 0.15% HNO_3 in all calibration standards.

Instrumental Parameters (General)

1. Zinc hollow cathode lamp
2. Wavelength: 2139 A
3. Type of burner: Boling
4. Fuel: Acetylene
5. Oxidant: Air
6. Type of flame: Oxidizing
7. Photomultiplier tube: IP-28

Notes

1. High levels of silicon may interfere.
2. The air-acetylene flame absorbs about 25% of the energy at the 2139 A line.
3. The sensitivity may be increased by the use of low-temperature flames.

Trace Metals Analyses for Arsenic and Selenium
by Colorimetric Methods

From:

Methods for Chemical Analysis of Water and Wastes

1971

Environmental Protection Agency
NERC, AQC Laboratory
Cincinnati, Ohio

	STORET No: Total	01002
ARSENIC	Inorganic, Dissolved	00995
	Inorganic, Total	00997

1. Scope and Application

1.1 The silver diethyldithiocarbamate method determines inorganic arsenic when present in concentrations at or above 10 µg/l. The method is applicable to most fresh and saline waters in the absence of high concentrations of chromium, cobalt, copper, mercury, molybdenum, nickel, and silver.

1.2 Difficulties may be encountered with certain industrial waste materials containing volatile substances. High sulfur content of wastes may exceed removal capacity of the lead acetate scrubber.

2. Summary of Method

2.1 Arsenic in the sample is reduced to arsine, AsH_3, in acid solution in a hydrogen generator. The arsine is passed through a scrubber to remove sulfide and is absorbed in a solution of silver diethyldithiocarbamate dissolved in pyridine. The red complex thus formed is measured in a spectrophotometer at 535 nm.

3. Comments

3.1 In analyzing most surface and ground waters, interferences are rarely encountered. Industrial waste samples should be spiked with a known amount of arsenic to establish adequate recovery.

3.2 It is essential that the system be air-tight during evolution of the arsine, to avoid losses.

3.3 If concentration of sample and oxidation of any organic matter is desired to measure organically-bound arsenic, refer to Standard Methods, 13th Ed., Method 104B, p 65, Procedure 4.a (1971).

4. Precision and Accuracy

4.1 A synthetic unknown sample containing 40 µg/l, as As, with other metals was analyzed in 46 laboratories. Relative standard deviation was 13.8% and relative error was 0%.

5. Reference

5.1 The procedure to be used for this determination is found in:

Standard Methods for the Examination of Water and Wastewater, 13th Edition, p 62, Method 104A (1971).

SELENIUM

(Diaminobenzidine Method)

STORET NUMBERS:
DISSOLVED 01145
TOTAL 01147

1. Scope and Application

1.1 This colorimetric method covers the determination of selenium in drinking waters and surface waters, domestic and industrial wastes, and saline waters.

1.2 The method covers the range from 0.003 - 0.05 mg selenium per liter.

2. Summary of Method

2.1 All selenium compounds present in the sample are first oxidized to selenate by acid permanganate. The selenate is then reduced to selenite. Addition of diaminobenzidine reagent forms the piazselenol complex which is subsequently extracted into toluene and the absorbance measured at 420 nm. The piazselenol color is stable, but evaporation of toluene concentrates the color to a marked degree in a few hours.

3. Comments

3.1 For the measurement of dissolved selenium, the sample must first be filtered through a 0.45 µ membrane filter.

3.2 Evaporation of solutions of sodium selenate to complete dryness can result in substantial loss of selenium unless calcium has been added to the sample.

3.3 Temperature, time, and acid concentrations are critical to obtain quantitative reduction without loss of selenium. The optimum pH for the formation of piazselenol is approximately 1.5.

3.4 No inorganic compounds are known to give a positive interference. Negative interference results from compounds that lower the concentration of diaminobenzidine by oxidizing this reagent. The addition of EDTA eliminates negative interference from at least 2.5 mg ferric iron. Iodine, and to a lesser extent bromide, causes low results.

3.5 When iodide or bromide interferences are encountered, a distillation step is required. This entails the addition of 50 ml KBr-H_2SO_4 reagent and 1 ml 30% H_2O_2 to the residue remaining after the evaporation step. The mixture is distilled until the color of bromine is gone from the flask. Diaminobenzidine is then added to the distillate and the piazselenol complex extracted into toluene.

4. Precision and Accuracy

4.1 A synthetic unknown sample containing 20 µg/l Se, 40 µg/l As, 250 µg/l Be, 240 µg/l B, and 6 µg/l V in distilled water was determined by the diaminobenzidine method, with a relative standard deviation of 21.2% and a relative error of 5.0% in 35 laboratories.

5. Reference

5.1 The procedure to be used for this determination is found in: Standard Methods for the Examination of Water and Wastewater, 13th Edition, p 296 Method 150 A (1971).

Chelation-Extraction Techniques for Chromium

From:

E. Brown, M. W. Skougstad, and M. J. Fishman, "Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases," Book 5, Chapter A1, U.S. Geological Survey, Denver, Colorado, 1970.

3. Interferences

The optimum pH for the extraction of the Cr-APDC complex by MIBK is 3.1. At this pH, however, manganese is also partially extracted. The Mn-APDC complex is unstable and decomposes to a fine suspension of manganese oxides which clog the atomizer-burner. If the pH of the sample is adjusted to 2.4 prior to chelation and extraction, less manganese is extracted, and there is only a slight loss in extraction efficiency for chromium. If the extract is not clear after overnight standing, it must be centrifuged. The method is otherwise free from interference from elements commonly found in fresh water.

4. Apparatus

See "Chromium, Hexavalent, Atomic-Absorption Method—Chelation-Extraction."

5. Reagents

5.1 *Ammonium pyrrolidine dithiocarbamate* (APDC) solution: Dissolve 1.0 g APDC in demineralized water and dilute to 100 ml. Prepare fresh daily.

5.2 *Bromphenol blue indicator* solution: Dissolve 0.1 g bromphenol blue in 100 ml 50-percent ethanol.

5.3 *Chromium* standard solution I, 1.00 ml=80 μg Cr^{+6}: Dissolve 0.2263 g pure dried $K_2Cr_2O_7$ in demineralized water and dilute to 1,000 ml.

5.4 *Chromium* standard solution II, 1.00 ml=2.00 μg Cr^{+3}: Pipet 5.0 ml chromium standard solution I into an erlenmeyer flask. Add approximately 15 mg Na_2SO_3 and 0.5 ml concentrated HNO_3 (sp gr 1.42). Gently evaporate just to dryness; strong heating reoxidizes the Cr. Add 0.5 ml concentrated HNO_3 and again evaporate to dryness to destroy any excess sulfite. Dissolve the residue in 1 ml concentrated HNO_3 with warming and dilute to 200 ml with demineralized water.

5.5 *Chromium* standard solution III, 1.00 ml=0.50 μg Cr^{+3}: Dilute 25.0 ml chromium standard solution II to 100 ml with demineralized water. Prepare immediately before use.

5.6 *Methyl isobutyl ketone* (MIBK).

5.7 *Potassium permanganate* solution: Dissolve 0.32 g $KMnO_4$ in demineralized water and dilute to 100 ml. Allow to stand several days and decant if necessary.

5.8 *Sodium azide* solution: Dissolve 0.10 g NaN_3 in 100 ml demineralized water.

5.9 *Sodium hydroxide* solution, 1*M*: Dissolve 40 g NaOH in demineralized water and dilute to 1 liter.

5.10 *Sulfuric acid*, 0.12*M*: Slowly add 6.5 ml concentrated H_2SO_4 (sp gr 1.84) to demineralized water and dilute to 1 liter.

6. Procedure

Samples should be collected according to instructions given in "Part I, Sample Collection and Treatment."

6.1 Pipet a volume of sample containing less than 2.5 μg chromium (100 ml maximum) into a 200-ml volumetric flask, and adjust the volume to approximately 100 ml. The pH must be 2.0 or less. Add concentrated HNO_3 if necessary.

6.2 Acidify a liter of demineralized water with 1.5 ml concentrated HNO_3. Prepare a blank and sufficient standards, and adjust volumes to approximately 100 ml with the acidified demineralized water.

6.3 Add $KMnO_4$ solution by drops to blank, standards, and samples until a faint pink color persists.

6.4 Heat on a steam bath for 20 min. If the color disappears, add $KMnO_4$ by drops to maintain a slight excess.

6.5 While still on the steam bath, add sodium azide solution by drops until the $KMnO_4$ color just disappears. Heat for about 2 min between each addition and avoid adding any excess. Continue heating for 5 min after adding the last drop of sodium azide solution.

6.6 Transfer to a water bath and cool to room temperature.

6.7 Remove from the water bath and filter through Whatman No. 40 filter paper any sample which has a brownish precipitate or coloration which may interfere with the pH adjustment.

6.8 Add 2.0 ml 1*M* NaOH and 2 drops bromphenol blue indicator solution. Continue the addition of 1*M* NaOH by drops to all samples and standards in which the indicator change from yellow to blue has not occurred. Add 0.12*M* H_2SO_4 by drops until the blue color just disappears, then add 2.0 ml in excess. The pH at this point will be 2.4.

6.9 Add 5.0 ml APDC solution and mix. The pH at this point will be 2.8.

6.10 Add 10.0 ml MIBK and shake vigorously for 3 min.

6.11 Allow the layers to separate and add demineralized water until the ketone layer is completely in the neck of the flask.

6.12 Stopper and allow to stand overnight. The Cr-APDC complex is stable for at least 36 hrs.

6.13 Aspirate the ketone layer and record the scale reading for each standard and sample against the blank. Repeat, and average the duplicate results.

7. Calculations

Determine the μg/l Cr in each sample from a plot of scale readings of standards. Since a scale expansion of 10× is used, it is not necessary to convert scale readings to absorbance. Exact reproducibility is not obtained, and a working curve must be prepared with each set of samples.

8. Report

Report Cr concentrations as follows: Less than 10 μg/l, nearest μg/l; 10 μg/l and above, two significant figures.

9. Precision

Single-operator precision of this method based on 10 determinations at the 5.0-μg/l level was found to be 0.57 μg/l.

References

Lieber, Maxim, 1956, Permanganate-azide test for total chromium in water: Am. Water Works Assoc. Jour., v. 48, p. 295.

Saltzman, B., 1952, Microdetermination of chromium with diphenylcarbazide by permanganate oxidation: Anal. Chemistry, v. 24, p. 1016.

APPENDIX B

TABLE OF ALL DATA EVALUATED

USEPA METHOD STUDY 7, TRACE METALS

TABLE 4: ALL DATA RECEIVED FOR ALUMINUM IN DISTILLED WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	1500.	430.	640.	1030.	<200.	<200.
1021	1400.	550. CT	660. CT	1000.	110. CT	90. CT
1031	1660.	1300.	940.	940.	550.	550.
1061	1220. CT	463. CT	515. CT	1195. CT	11. CT	11. CT
1091	1300.	700.	700.	1000.	200.	200.
1101	1300.	500. CT	670. CT	1000.	50. CT	30. CT
1111	1270. CT	510. CT	550. CT	880. CT	<100. CT	<100. CT
1121	800.	280.	340.	560.	34. CT	
1131	1140.	500.	520.	970.	30.	60.
1151	1224.	520.	674.	1040.	0.0	0.0
1221	1330.	500.	650.	1020.		
1371	500.	640.	500.	820.	<100.	220.
1481	1100.	500.	750.	1000.	<100.	<100.
1501	1250. CT	620. CT	870. CT	1000. CT		
1521	1300.	500.	700.	1000.	45.	26.
1571	1200.	420.	500.	870.	00.	00.
1691	620.	310.	400.	520.	90.	90.
1951	1300. DM	580. DM	715. DM	1000. DM	60. DM	32. DM
2041	960.	340.	500.	82.	55. CT	45. CT
2121	1167.	333.	500.	833.	167.	0.
2521	1400.	600.	700.	1000.	100.	60.
2591	1130. CT	535. CT	650. CT	990. CT	100. CT	<100. CT
2621	1020.	530.	540.	1010.	<200.	210.
2791	1100. EX	550. EX	770. EX	1000. EX	300. EX	200. EX
2821	1205.	450.	542.	1039.		
2911	1160.	500.	620.	1000.	100.	100.
3091	1300.	1000.	800.	1000.	<30.	<30.
3221	1000.	500.	500.	1000.		
3291	1225.	525.	504.	1025.	288. EX	50. EX
3381	900.	600.	600.	900.	<100.	<100.
3521	1300.	470.	580.	1000.	67.	39.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 4: ALL DATA RECEIVED FOR ALUMINUM IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
3741	1400.	600.	800.	1200.	100.	
3931	1500.	400.	1000.	1400.	300.	400.
3971	1200.	700.	700.	1200.	200.	300.
4401	1180.	570.	510.	1014.	<500.	<500.
4431	1155. CT	454. CT	652. CT	969. CT	88. CT	35. CT
4441	870.	220.	270.	670.	< 50.	< 50.
4461	1380. EX	490. EX	755. EX	560. EX	40. EX	30. EX
4521	1200.	500.	600.	1000.		
4531	1400.	500.	600.	1000.	<100.	<100.
4561	1240.	500.	660.	1030.	30.	70.
4581	1578.	0.	0.	32.	0.	0.
4591	1300.	1000.	1000.	800.	0.	0.
4631	1231.	424.	596.	1002.	<100.	
4651	1210.	450.	540.	1150.	150.	150.
4671	1000.	500.	500.	1000.	0.	0.
4681	1200.	600.	700.	900.	0.	100.
4701	1570.	376.	512.	1139.	39. CT	21. CT
4721	2101.	983.	972.	1903.	<100.	121.
4751	1000.	500.	550.	1000.	40. EX	20. EX
4811	906.0	457.0	472.0	888.0	<100.0	<100.0
4921	<1000.	<1000.	<1000.	<1000.	<1000.	<1000.
4931	1200. EX	500. EX	620. EX	1000. EX	50. EX	27. EX
4961	103.	92.	116.0	86.	12.	7.4
4971	1300.	450.	700.	950.	<400.	<400.
4981	1281.	.76	0.63	1487.	0.53EX	0.64EX
5021	1400. DM	500. DM	590. DM	1000. DM	90. DM	37. DM
5181	1300.	600.	600.	1000.	100.	100.
5391	1000.	50. CT	40. CT	1200.	530. CT	640. CT
5401	1193.	502.	616.			
5511	1230.	510.	620.	950.	60.	20.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 5: ALL DATA RECEIVED FOR ALUMINUM IN NATURAL WATER, UG/L

LAB/ ANALYST	SAMPLE 1		SAMPLE 2		SAMPLE 3		SAMPLE 4		SAMPLE 5		SAMPLE 6	
1011	1530.		330.		610.		930.		<200.		<200.	
1021	1100.		400.		500.		1100.					
1031	2140.		1500.		1660.		2000.		940.		550.	
1061	1369.	CT	589.	CT	689.	CT	1168.	CT	35.	CT	10.	CT
1091	1400.		500.		800.		1000.		100.		400.	
1101	1250.		550.	CT	750.	CT	1150.		20.	CT	150.	CT
1111	1320.	CT	550.	CT	630.	CT	970.	CT	<100.	CT	<100.	CT
1121	690.		270.		310.		630.		27.	CT	19.	CT
1131	1110.		430.		520.		820.		30.		0.	
1151	976.		241.		331.		802.		0.0		0.0	
1221	1250.		380.		580.		920.					
1371	1000.		350.		350.		350.		100.		<100.	
1521	1200.		500.		700.		1000.		47.		28.	
1571	1350.		500.		600.		980.		50.		20.	
2041	1020.		420.		460.		74.					
2121	1167.		333.		500.		833.		167.		0.	
2521	1240.		640.		640.		840.		20.		20.	
2591	1150.	CT	525.	CT	632.	CT	970.	CT	100.	CT	<100.	CT
2621	1070.		510.		450.		1060.		<200.		<200.	
2791	900.	EX	530.	EX	850.		750.	EX	300.	EX	200.	EX
2821	1150.		467.		590.		1070.					
3091	1400.		800.		800.		1000.		<30.		<30.	
3221	1000.		500.		500.		1000.		0.		0.	
3291	1225.		513.		625.		1063.		213.	EX	53.	EX
3381	600.		600.		600.		900.		<100.		<100.	
3521	1300.		510.		590.		1100.		65.		46.	
3741	1500.		700.		800.		1300.		100.		100.	
3931	1600.		500.		1200.		1500.		400.		700.	
3971	1200.		700.		700.		1100.		300.		200.	

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 5: ALL DATA RECEIVED FOR ALUMINUM IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4401	1475.	610.	885.	1210.	<500.	<500.
4431	1806. CT	951. CT	1015. CT	1329. CT	283. CT	37. CT
4461	1260. EX	395. EX	575. EX	210. EX		
4521				1100.		
4561	1250.	520.	610.	990.	30.	10.
4581	1438.	0.	64.	26.	121.	0.
4591	1400.	1000.	1300.	900.	0.	0.
4631	1301.	428.	600.	1008.		
4651	1060.	460.	460.	1060.	160.	160.
4671	1250.	600.	600.	1250.	0.	0.
4681	1300.	600.	600.	1000.	0.	100.
4701	1640.	400.	575.	1115.	30. CT	21. CT
4721	2047.	919.	1168.	1883.	194.	465.
4811	950.0	438.0	378.0	842.0	<100.0	<100.0
4921	<1000.	<1000.	<1000.	<1000.	<1000.	<1000.
4931	1240. EX	500. EX	620. EX	1000. EX	52. EX	36. EX
4961	99.	95.	110.	88.	15.	7.8
4971	1450.	550.	600.	1250.	<400.	<400.
4981	1521.	0.89	0.79	1510.	0.49EX	0.80EX
5181	1800.	1100.	1200.	1000.	100.	0.
5391		20. CT	70. CT	1300. CT	480. CT	660. CT
5401	1127.	435.	692.			
5511	1280.	510.	580.	1090.	20.	50.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

TABLE 6: ALL DATA RECEIVED FOR ARSENIC IN DISTILLED WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	405.	78.	70.	295.	32.	26.
1021	300.	90.	70.	320.	30.	22.
1031	215.	100.	50.	150.	8.0	12.
1061	308.	84.	67.	237.	18.	17.
1092	257.	83.	66.	229.	29.	23.
1102	620.	120. CT	120. CT	390.	50. CT	60. CT
1121	277.	69.	63.	234.	29. CT	23. CT
1131	311.	9.	0.	267.	2.	10.
1241	285.	70.	65.	480.	28.	13.
1371	11.4	2.7	3.0	9.0	1.7	1.0
1481	306.	80.	80.	306.	20.	40.
1521	250.	74.	60.	210.	24.	12.
1571	220.	59.	47.	149.	20.	10.
1681	280.	26.	14.	280.	60.	60.
1691	280.	100.	70.	260.	30.	20.
1901	274.	76.	64.	218.	24.	18.
1951	253.	78.	64.	268.	20.	6.
2041	325.	55.	23.	252.	25.	< 13.
2501	317.	37.	43.	157.	23.	8.6
2591	246.	80.	60.	224.	27.	15.
2621	250. DM	52. DM	56. DM	270. DM	16. DM	40. DM
2671	320. DM	66. DM	45. DM	260. DM	24. DM	17. DM
2791	40.	70.	11.	70.	30.	26.
2911	1900.	54.	46.	1400.	15.	10.
3091	250.	80.	40.	250.	30.	20.
3221	317.	86.	63.	284.	27.	15.
3291	199.	5.	6.	104.	8.	< 1.
3381	246.	57.	51.	217.	29.	26.
3521	270.	55.	49.	230.	< 30.	< 30.
3931	250.	100.	70.	260.	50.	50.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 6: ALL DATA RECEIVED FOR ARSENIC IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4021	369.0	95.0	90.0	258.0	28.0	17.0
4221	304. DM	82. DM	69. DM	271. DM	34. DM	20. DM
4411	298. CT	82. CT	68. CT	280. CT	29. CT	19. CT
4431	315.	72.	58.	265.	2.	4.
4441	156.	44.	45.	199.	6.	< 4.
4461	290.	70.	50.	290.		
4472	250.	68.	60.	250.	26.	20.
4481	240.	56.	46.	221.	6.6	4.9
4531	220.	80.	65.	250.	24.	18.
4551	314.	71.	62.	276.	22.	22.
4561	190.	50.	60.	180.	20.	20.
4581	206.	46.	37.	183.	37.	17.
4611	169.	25.	12.	305.	71.	43.
4641	25.	1.	2.	26.	0.5	1.
4681	210.	100.	70.	250.	40.	30.
4702	140.	57.	43.	138.	29.	67.
4721	224.	60.	11.	204.	8.3	2.1
4751	398.	40.	69.	302.	< 20.	< 20.
4861	336.	92.	75.	298.	30.	21.
4881	170.8			197.5		
4921	109.	17.	16.	129.	< 1.	< 1.
4941	234.0	60.0	63.0	237.0	26.0	6.0
4961	145.	81.	58.	119.	28.	19.
5021	300. DM	88. DM	67. DM	270. DM	29. DM	20. DM
5031	232.	85.	55.	262.	26.	20.
5041	271.	63.	53.	229.	0.23	0.0
5051	276.	78.	52.	234.	22.	13.
5061	298.	81.	64.	278.	29.	21.
5291	11.	3.	1.4	11.	.6	.2
5401	240.	74.	53.			
5511	264.	50.	42.	208.	4.	

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 7: ALL DATA RECEIVED FOR ARSENIC IN NATURAL WATER, UG/L

LAB/ ANALYST	SAMPLE 1		SAMPLE 2		SAMPLE 3		SAMPLE 4		SAMPLE 5		SAMPLE 6	
1011	328.		111.		85.		270.		32.		26.	
1021	288.		96.		60.		298.		22.		14.	
1031	150.		100.		80.		140.		29.		12.	
1061	286.		83.		83.		251.		33.		26.	
1092	257.		84.		71.		197.		23.		20.	
1102	220.		80.	CT	80.	CT	330.		110.	CT	140.	CT
1121	229.		74.		60.		231.		31.	CT	17.	CT
1131	210.		32.		0.		195.		2.		0.	
1241	270.		94.		60.		320.		25.		16.	
1371	14.5		3.3		3.0		12.5		1.0			
1521	260.		73.		59.		202.		23.		14.	
1571			54.		42.				18.		6.	
1901	286.		62.		59.		215.		30.		16.	
2041	305.		83.		45.		252.		20.		13.	
2501	398.		71.		48.		257.		28.		14.4	
2591	240.		80.				214.		26.		14.	
2621	280.	DM	56.	DM	68.	DM	200.	DM	48.	DM	16.	DM
2671	340.	DM	61.	DM	50.	DM	240.	DM	24.	DM	15.	DM
2791	57.		40.		9.		67.		28.		20.	
3091	250.		60.		50.		240.		20.		20.	
3221	295.		75.		62.		242.		32.		20.	
3291	202.		15.		< 1.		134.		5.		9.	
3381	242.		60.		51.		208.		22.		17.	
3521	280.		72.		59.		270.		< 30.		< 30.	
3931	250.		100.		70.		260.		50.		50.	
4221	315.	DM	80.	DM	70.	DM	256.	DM	29.	DM	20.	DM
4411	300.	CT	83.	CT	69.	CT	284.	CT	30.	CT	20.	CT
4431	224.		27.		17.		158.		4.		2.	
4461	290.		90.		50.		290.					
4472	289.		80.		62.		243.		27.		20.	
4481	234.		49.		39.		203.		10.		3.1	

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 7: ALL DATA RECEIVED FOR ARSENIC IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4551	278.	68.	61.	264.	26.	20.
4561	190.	40.	60.	190.	30.	10.
4581	211.	57.	37.	206.	23.	14.
4611	183.	79.	56.	389.	117.	99.
4641	25.	3.	2.	24.	1.	2.
4681	240.	80.	30.	250.	30.	20.
4702	129.	63.	29.	143.	34.	60.
4721	258.	57.	11.	224.	8.0	< 1.0
4861	343.	87.	72.	303.	31.	22.
4921	109.	20.	9.	114.	< 1.	< 1.
4941	234.0	77.0	63.0	237.0	34.0	17.0
4961	140.	84.	53.	123.	25.	22.0
5031	262.	85.	55.	262.	30.	21.
5041	281.	60.	57.	246.	0.91	0.23
5051	328.	146.	135.	316.	97.	87.
5061	290.	78.	66.	270.	30.	20.
5291	12.	3.2	2.6	11.	.6	.2
5401	236.	78.	58.			
5511	259.	68.	44.	251.	12.	

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 8: ALL DATA RECEIVED FOR CADMIUM IN DISTILLED WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	65.	17.	18.	73.	4.2 EX	1.7 EX
1012		14. SB	17. SB		< 2.5 SB	3.2 SB
1021	62.	14. CT	17. CT	74.	1. CT	2. CT
1031	90.	16.	14.	77.	7.0 EX	8.0 EX
1061	70.0 CT	10.5 CT	11.5 CT	70.0 CT	1.8 CT	2.8 CT
1091	55.		15.	63.		
1111	72. CT	14. CT	17. CT	74. CT	< 2.5 CT	3. CT
1121	75.	15.	20.	77.	2. CT	2. CT
1131	69.	13.	14.	77.	2.	3.
1161	76.	< 7.	26.	63.	< 7.	< 7.
1171		12.	18.		1.40	1.80
1221	73.	12.	22.	77.		
1241	71.	14.	19.	76.	2.0	7.0
1301	<250.	<250.	<250.	<250.	<250.	<250.
1371	72.0 EX	12.0 EX	20.0 EX	180. EX	3.0 EX	2.0 EX
1381	70.	10.	< 10.	60.	0.1 EX	.1 EX
1401	7.1 DM	2.86DM	3.49DM	7.6 DM	0.33DM	0.58DM
1451	65. EX	14. EX	17. EX	72. EX	1. EX	3. EX
1471	74.	24.	26.	82.	2.0 EX	2.8 EX
1481	48.	< 10.	21.	68.	< 10.	18.
1501	70. EX	10. EX	20. EX	60. EX		
1521	63.	15. EX	19. EX	72.	2. EX	7. EX
1571	70.	20.	20.	80.	10.	00.
1681	70.	< 10.	< 10.	70.	< 10.	< 10.
1691	7.6 DM	5.2 DM	6.8 DM	8.0 DM	2.2 DM	3.8 DM
1901	68.	11.	11.	74.	1.	0.
1951	73. EX	22. EX	19. EX	86. EX	2.0 EX	3.5 EX
2041	81.	19.	22.	86.	2. EX	3. EX
2121	67.	13.	17.	77.	0.	0.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 8: ALL DATA RECEIVED FOR CADMIUM IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
2301	77.	13.	17.	72.	< 6.	< 6.
2491	40.	30.	40.	80.	4. CT	3. CT
2501	82.			65.		
2521	61.	8.	100.	66.	2.4	3.7
2591	74. EX		19. EX	86. EX	1.2 EX	2.8 EX
2621	106. EX	16. EX	19. EX	99. EX	< 1.0 EX	2.8 EX
2671	44.	7.	9.	57.	1.3 EX	3.8 EX
2721	51.5 EX	7.8 EX	7.0 EX	17.0 EX	2.0 EX	1.8 EX
2731	64.			74.		
2791	79.	10. EX	11. EX	80.	3.0 EX	4.1 EX
2821	60.	14. EX	18. EX	71.	0.95EX	2.2 EX
2911	62.	9.	11.	66.		
3091	70.	< 50.	< 50.	60.	< 50.	< 50.
3221	110.	11.	14.	110.	1.5 E	X 2.8 E
3241	81.	12.	25.	87.		
3291	83.	5. EX	29. EX	80.	14. EX	< 1. EX
3381	72.	20.	20.	72.	2.5 EX	3.2 EX
3521	71.	16.	18.	78.	4.	5.
3561	100.	70.	60.	210.	130.	90.
3741	60.	10.	10.	70.		
3791	65. DM	13. DM	18. DM	79. DM	1.4 DM	2.7 DM
3931	60. EX	13. EX	18. EX	68. EX	4. EX	4. EX
3971	80.	0.	0.	80.	0.	10.
4221	99. EX	24. EX	28. EX	102. EX	4. EX	6. EX
4411	59. CT	14. CT	18. CT	69. CT	1.1 CT	3.0 CT
4421	58.	10.	10.	63.	1. CT	2. CT
4431	90. CT	18. CT	30. CT	84. CT	1.7 CT	2.7 CT
4441	20.	22.	< 10.	40.	< 10.	< 10.
4451	60.	10.	10.	70.	< 10.	< 10.
4461	70.	20.	20.	40.	1.5 EX	2.7 EX
4471	59.	10.	11.	71.	< 2.	1.
4481	100. EX	17. EX	20. EX	90. EX		

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 8: ALL DATA RECEIVED FOR CADMIUM IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4501	50.	35.	33.	51.	12.	2.
4511	64. EX	14. EX		71. EX	0.4 EX	2.0 EX
4521	73. SB	15.9 SB	18.9 SB	77. SB	11.4 SB	2.8 SB
4531	70. EX	21. EX	18. EX	84. EX	2.4 EX	3.2 EX
4561	60.	< 10.	20.	70.	<10.	< 10.
4571	70.	16.	20.	70.	15.	20.
4581	95.	0.	40.	38.	49.	0.
4601	67.	< 25.	25.	81.	<25.	< 25.
4631	56. EX	18. EX	22. EX	5.0 EX	68. EX	2.5 EX
4641	7.	11.	16.	85.	0.	2.
4651	60.	10.	7.	60.		
4671	80.	0.	1.0	70.	4.	4.
4681	200. EX	40. EX	48. EX	235. EX	3. EX	4. EX
4691	100.	50.	50.	100.		
4701	65.	13. EX	15. EX	74.	1.2 EX	2.4 EX
4711	1500. EX	280. EX	0. EX	1100. EX	1200. EX	0. EX
4721	70.	16.	13.	79.	3.	1.
4731	68.	15.	17.	73.		
4751	65.	15.	17.	60.	1. EX	2. EX
4761	140.	40.	100.	140.	0.	0.
4771	68.	13.	15.	62.	5.	5.
4781	262.4 EX	64.0 EX	79.6 EX	296.5 EX	19.0 EX	23.6 EX
4791	70. EX	20. EX	20. EX	80. EX	1.5 EX	2.5 EX
4801	77.	13. EX	17. EX	77.	2.1 EX	3.0 EX
4811	59.0	29.0	20.0	78.0	1.0	2.0
4821	78.	< 20.	20.	82.	< 20.	< 20.
4831	67.	9.	13.	46.	3.	3.
4841	80.	20.	30.	90.	0.	0.
4871	69.	0.	10.	89.	0.	0.
4881	441. EX	101. EX	126. EX	407. EX	19. EX	53. EX
4891	68.	16.	19.	74.	0.	1.
4901	33.	13.	16.	28.	3.	7.
4921	67.	18.	19.	75.	2. EX	2. EX
4931	70. EX	14. EX	18. EX	80. EX	1.5 EX	2.5 EX
4941	69.0	20.0	19.0	74.0	0.0	0.0
4961	7.5 EX	3.3 EX	4.1 EX	8.2 EX	0.6 EX	0.8 EX
4971	68.	13.	15.	71.	4. EX	4. EX
4981	82.	25.	25.	84.	0.40EX	0.96EX
4991	83.	29.	27.	76.	.26EX	.30EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

TABLE 8: ALL DATA RECEIVED FOR CADMIUM IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
5021	190. DM	41. DM	86. DM	210. DM		
5031	56. CT	8. CT	12. CT	61. CT	1. CT	4. CT
5041	70.	21.	11.	68.	0.0	2.0
5061	70.	14. EX	17. EX	75.	1.0 EX	2.4 EX
5071	100.	14. EX	18. EX	125.	< 1.0 EX	< 1.0 EX
5181	70.	15.	200.	80.	0.	0.
5291	72.	14.	18.	76.	1.0	2.6
5371	0.1			0.1		
5391	78. CT	1. CT	2. CT	72. CT	14. CT	17. CT
5401	68.	15.	18.			
5501	90.	40.	40.	93.	3. EX	5. EX
5511	65.	15.	17.	71.	.6 EX	2.1 EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

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TABLE 9 : ALL DATA RECEIVED FOR CADMIUM IN NATURAL WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	67.	18.	25.	77.	3.8 EX	1.7 EX
1012		16. SB	14. SB		5.1 SB	3.1 SB
1021	72.	14. CT	16.	72.	1.	2. CT
1031	74.	9.5	7.3	80.	1.0 EX	< 1.0 EX
1061	69.2 CT	13.2 CT	16.2 CT	69.2 CT	1.0 CT	2.7 CT
1091	61.		13.	71.		
1111	70. CT	14. CT	18. CT	72. CT	< 2.5 CT	3. CT
1121	71.	15.	22.	73.	2. CT	2. CT
1131	69.	13.	13.	77.	1.	2.
1161	66.	< 7.	26.	66.	< 7.	< 7.
1171	78.	13.	18.	85.	1.40	1.60
1221	70.	18.	23.	82.		
1241	59.	14.	14.	63.	3.0	3.0
1371	74.0 EX	14.0 EX	19.0 EX	66.0 EX	3.0 EX	2.0 EX
1381	50.	< 10.	< 10.	70.	0.1 EX	.1 EX
1401	.1 DM	0. DM	0. DM	.33DM	0.0 DM	0. DM
1451	68. EX	14. EX	17. EX	74. EX	1. EX	3. EX
1471	73.	23.	25.	81.	1.4 EX	3.4 EX
1501	70. EX			60. EX		
1521	63.	14. EX	20. EX	71.	4. EX	5. EX
1571	70.	20.	20.	80.	10.	00.
1901	71.	14.	20.	78.	0.	1.
2041	81.	18.	20.	86.	1. EX	3. EX
2121	70.	17.	20.	80.	0.	0.
2301	61.	12.	13.	76.	< 6.	< 6.
2491	50.	30.	30.	90.	5. CT	4. CT
2501	75.			105.		
2521	60.	7.	139.	65.	.7	2.5
2591	74. EX	15. EX	19. EX	86. EX	1.2 EX	2.8 EX
2621	100. EX	16. EX	20. EX	104. EX	1.9 EX	2.8 EX
2671	69.	17.	16.	60.	1.6 EX	4.1 EX
2731	72.			75.		
2791	81.	11. EX	11. EX	70. EX	3.0 EX	4.0 EX
2821	66.	14. EX	19. EX	74.	1.4 EX	2.9 EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 9: ALL DATA RECEIVED FOR CADMIUM IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
3091	80.	< 50.	< 50.	80.	< 50.	< 50.
3221	110.	11.	14.	110.	1.5 EX	2.8 E
3241	67.	11.	19.	85.		
3291	69.	5. EX	21. EX	81.	15. EX	< 1.
3381	64.	20.	23.	72.	2.0 EX	3.6 EX
3521	71.	16.	18.	76.	4.	5.
3561	140.	170.	150.	250.	50.	160.
3741	70.	10.	10.	70.		
3931	60. EX	13. EX	16. EX	68. EX	2. EX	3. EX
3971	80.	0.	0.	70.	0.	10.
4221	99. EX	23. EX	27. EX	102. EX	6. EX	6. EX
4411	60. CT	14. CT	17. CT	68. CT	1.3 CT	2.9 CT
4421	57.	8.	10.	57.	0. CT	1. CT
4431	100. CT	28. CT	35. CT	82. CT	3.4 CT	6.6 CT
4451	60.	10.	10.	70.	< 10.	< 10.
4461	70.	20.	20.		1.4 EX	3.2 EX
4471	63.	12.	14.	70.	< 2.	-0.5
4481	100. EX	17. EX	20. EX	80. EX		
4501	51.	32.	33.	52.	22.	12.
4511	69. EX	13. EX		75. EX	0.4 EX	2.4 EX
4521				78. SB		
4561	60.	< 10.	10.	70.	< 10.	< 10.
4571	70.	15.	20.	71.	16.	22.
4581	97.	13.	30.	49.	41.	0.
4601	67.	< 25.	< 25.	81.	< 25.	< 25.
4641	8.	24.	26.	94.	6.	7.
4651	50.	5.	6.	50.		
4671	80.	0.	0.	70.	0.	0.
4681	260. EX	38. EX	60. EX	250. EX	4. EX	3. EX
4691	100.	50.	60.	100.		

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

TABLE 9: ALL DATA RECEIVED FOR CADMIUM IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4701	65.	13. EX	15. EX	74.	1.4 EX	2.3 EX
4711	1200. EX	400. EX	0. EX	1100. EX	1200. EX	0. EX
4721	69.	16.	11.	78.	2.	1.
4731	78.	20.	22.	96.		
4751					1. EX	2. EX
4761	140.	50.	110.	140.	0.	0.
4771	60.	13.	15.	61.	5.	5.
4781	262.6 EX	60.0 EX	79.4 EX	299.6 EX	10.0 EX	12.0 EX
4791	70. EX	20. EX	20. EX	80. EX	1.5 EX	2.5 EX
4801	77.	14. EX	18. EX	77.	3.4 EX	4.3 EX
4811	69.0	28.0	26.0	83.0	1.0	2.0
4821	75.	< 20.	20.	75.	< 20.	< 20.
4871	72.	0.	10.	75.	0.	0.
4881	441. EX	105. EX	113. EX	396. EX	21. EX	46. EX
4891	68.		21.	76.	3.	3.
4901	28.	12.	14.	32.	1.	7.
4921	66.	16.	16.	70.	1. EX	2. EX
4931	70. EX	14. EX	18. EX	80. EX	1.5 EX	2.5 EX
4941	64.0	9.0	15.0	70.0	0.0	0.0
4961	8.0 EX	3.9 EX	4.9 EX	9.0 EX	0.4 EX	1.0 EX
4971	71.	15.	17.	74.	4. EX	4. EX
4981	84.	21.	25.	85.	0.40EX	2.00EX
4991	76.	28.	26.	83.	.28EX	.31EX
5031	57. CT	11. CT	15. CT	61. CT	3. CT	4. CT
5041	69.	15.	13.	70.	0.0	9.0
5061	70.	14. EX	17. EX	76.	1.0 EX	2.4 EX
5071	100.	14. EX	17. EX	125.	< 1.0 EX	< 1.0 EX
5181	70.	15.	200.	80.	0.	0.
5291	71.	12.	18.	76.	1.0	2.0
5371	0.1			0.1		
5391		< 5. CT	3. CT	70. CT	13. CT	15. CT
5401	73.	14.	15.			
5501	90.	30.	33.	91.	3. EX	4. EX
5511	64.	14.	15.	72.	1.0 EX	2.2 EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 10: ALL DATA RECEIVED FOR CHROMIUM IN DISTILLED WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	365.	80.	105.	410.	< 30.	< 30.
1021	350.	80.	100.	380.	11. CT	16. CT
1031	508.	< 1.0 EX	115.	568.	< 1.0 EX	< 1.0 EX
1061	369. CT	76. CT	96. CT	408. CT	10. CT	16. CT
1091	180.	20.	30.	190.		
1101	360.	80. CT	100. CT	420.	10. CT	16. CT
1111	370. CT	72. CT	92. CT	402. CT	8. CT	18. CT
1121	310.	70.	90.	410.	8. CT	15. CT
1131	366.	74.	94.	392.	8.	16.
1161	350.	80.	90.	380.	< 25.	< 25.
1171		76.	86.		14.0	25.
1221	378.	79.	93.	414.		
1301	400.	100.	100.	400.	<100.	<100.
1371	50.0 DM	6.8 DM	8.5 DM	100. DM	1.3 DM	1.3 DM
1381	350.	70.	100.	40.		
1401	36.1 DM	15.6 DM	18.8 DM	39.4 DM	1.52DM	2.99DM
1451	380.	85. EX	90. EX	400.	8. EX	13. EX
1471	392.	75.	92.	418.	6.0 EX	11. EX
1481	360.	70.	100.	430.	8.	15.
1521	380.	83.	104.	420.	11.	17.
1571	370.	70.	90.	400.	10.	20.
1681	400.	10.	20.	360.	70.	90.
1691	350.	70.	70.	350.	< 1.	< 1.
1701	394.	76.	102.	480.	7.7	22.
1901	351.	71.	87.	388.	7. EX	15. EX
2041	384.	76.	106.	426.	8. EX	16. EX
2121	308.	100.	123.	421.	40.	100.
2301	423.	90.	115.	432.	< 10.	14.
2491	470.	60.	70.	500.	8. CT	12. CT
2501	370.	74.	93.	420.		
2521	390.	85.	100.	410.	7.	20.
2591	440.	80. CT	100. CT	495.	8. CT	18. CT
2621	437. EX	101. EX	130. EX	527. EX	6. EX	17. EX
2671	670.	100.	170.	680.	2. EX	10. EX
2721	285.	130.	90.	150.	370.	100.
2731	110.	62.	96.	447.		
2791	360.	69. EX	100. EX	400.	7.0 EX	13. EX
2821	373.	72.	90.	420.		

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 10: ALL DATA RECEIVED FOR CHROMIUM IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
2831	410. EX	115. EX	130. EX	500. EX	< 20. EX	< 20. EX
2911	375.	76.	80.	416.	9.	7.
3111	315.	61.	73.	371.	5. EX	15. EX
3221	400.	90.	95.	450.	10. EX	20. EX
3241	380.	100.	100.	380.		
3291	340.	58.	83.	316.	23. EX	7. EX
3381	385.	70.	100.	435.	< 5. EX	< 5. EX
3521	340.	55.	72.	360.	6.	13.
3561	600.	300.	400.	750.	50.	100.
3741	650.	130.	200.	740.	17. EX	9. EX
3791	336. DM	70. DM	90. DM	383. DM	7.2 DM	14.5 DM
3931	380.	260.	280.	580.	100.	80.
3971	400.	90.	110.	450.	0.	0.
4401	413.	90.	100.	481.	< 50.	< 50.
4411	450. CT	80. CT	100. CT	500. CT	9.0 CT	18. CT
4421	293.	57.	73.	303.	7. CT	13. CT
4431	350.	100.	96.	324.	12.2	47.
4441	450.	98.	120.	504.	250.	280.
4451	410.	80.	110.	410.	10.	20.
4461	360.	60.	90.	400.		10.
4471	265.	42.	50.	296.	-1.6	23.
4491	330.	74.	74.	380.		
4501	320.	100.	1.7	351.	13.	30.
4521	380.	80.	100.	410.		
4531	350.	140.	120.	400.	< 20.	25.
4551	295.	130.	<100.	350.	<100.	<100.
4561	380.	70.	90.	420.	< 10.	20.
4581	212.	68.	79.	256.	18.	39.
4591	0.	0.	0.	0.	0.	0.
4621	487. CT	114. CT	147. CT	438. CT	10. CT	24. CT
4641	409.	80.	98.	44.	0.	16.
4651	330.	60. EX	60. EX	310.	10. EX	10. EX
4671	250.	50.0	50.0	275.0	0.	0.
4681	400.	80.	110.	440.	10.	20.
4701	416. DM	63. EX	80. EX	410.	6.5 EX	14. EX
4711	510.	117.	117.	500.	105.	0.
4721	379.	69.	104.	394.	16.	23.
4731	355.	80.	110.	385.		

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 10: ALL DATA RECEIVED FOR CHROMIUM IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4741	550.	80.	85.	600.	40.	20.
4751	330.	50.	70.	400.	6. CT	14. CT
4761	430.	80.	100.	480.	0.	50.
4771	400.	100.	61.	500.	8.0	17.
4781	190.0	21.0	30.0	179.0		
4791	330. EX	60. EX	80. EX	350. EX	6.0 EX	12. EX
4801	375.	73. EX	90. EX	403.	10. EX	17. EX
4811	320.	68.0	107.0	412.0	< 10.0	20.
4821	220.	100.	100.	260.	<100.	<100.
4831	294.	49.	275.	10.	25.	25.
4841	380.	60.	100.	420.	0.	0.
4871	386.	54.	79.	396.	-10.	3.
4881	350.	30. EX	40. EX	420.	5. EX	10. EX
4901	95.	92. EX	112. EX	180.	7. EX	17. EX
4911	342.	66.	84.	380.	8.0	15.
4921	336. EX	62. EX	105. EX	400. EX	6. EX	14. EX
4922	360.	76.	100.	415.	28.	30.
4931	400. EX	80. EX	102. EX	430. EX	8.0 EX	16. EX
4941	550.00	80.00	110.00	520.00	0.0	0.0
4961	28. EX	13. EX	15. EX	32. EX	2.1 EX	3.8 EX
4971	400.	70.	120.	380.	< 40. EX	< 40. EX
4981	283.	83.	112.	428.	< 00.1 EX	< 00.1 EX
5001	370.	80.	100.	410.	< 50.	< 50.
5011	1800.	1650.	1650.	1800.	300.	400.
5021	480. DM	51. DM	150. DM	630. DM		
5022	430. DM		120. DM	430. DM	10. DM	18. DM
5031	365.	70.	90.	370.	9. CT	14. CT
5041	310.	60.	80.	420.	40.	30.
5061	370.	80.	95.	400.	8.0 EX	15. EX
5071	400.	90.	100.	480.	< 4. EX	< 4. EX
5181	360.	70.	70.	430.	10.	10.
5291	342.	73.	85.	390.	18.	25.
5361	397.	90.	103.	432.	11.	16.
5371	0.37	.09	.09	.42		
5391	500.	11. CT	13. CT	440.	65. CT	98. CT
5401	423.	79.	98.			
5501	440.	140.	160.	473.	9. EX	12. EX
5511	357.	68.	92.	397.	7.	16.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 11: ALL DATA RECEIVED FOR CHROMIUM IN NATURAL WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	380.	62.	103.	420.	< 30.	< 30.
1021	366.	76.	96.	396.	10.	14.
1031	391.	< 1.0 EX	< 1.0 EX	492.	< 1.0 EX	< 1.0 EX
1061	381. CT	69. CT	70. CT	410. CT	7. CT	10. CT
1091	180.	20.	30.	190.		
1101	370.	72. CT	91. CT	420.	12. CT	15. CT
1111	308. CT	62. CT	80. CT	345. CT	10. CT	12. CT
1121	310.	100.	100.	400.	8. CT	12. CT
1131	334.	64.	90.	359.	4.	8.
1161	350.	70.	70.	350.	< 25.	< 25.
1171	430.	91.	90.	452.	28.	23.
1221	378.	67.	93.	408.		
1371	12.0 DM	5.7 DM	5.7 DM	36. DM	2.4 DM	2.0 DM
1381	270.	40.	70.	30.		
1401	.1 DM	0.05 DM	0.33 DM	0.2 DM	0. DM	0. DM
1451	330.	90. EX	110. EX	360.	10. EX	13. EX
1471	392.	75.	92.	415.	6.4 EX	14. EX
1521	380.	85.	103.	428.	10.	17.
1571	370.	70.	90.	410.	10.	20.
1701	351.	73.	92.	388.	5.1	16.
1901	350.	68.	87.	385.	7. EX	16. EX
2041	379.	78.	98.	418.	8. EX	15. EX
2121	308.	82.	100.	421.	20.	20.
2301	429.	80.	102.	455.	< 10.	15.
2491	470.	50.	60.	510.	9. CT	11. CT
2501	300.	77.	85.	315.		
2521	287.	82.	97.	417.	3.	17.
2591	440.	80. CT	105. CT	495.	6. CT	18. CT
2621	397. EX	101. EX	110. EX	497. EX	6. EX	16. EX
2671	690.	140.	180.	740.	5. EX	12. EX
2731	110.	58.	96.	447.		
2791	320.	68. EX	117. EX	480.	23. EX	24. EX
2821	342.	67.	83.	389.		
2831	210. EX	70. EX	33. EX	178. EX	30. EX	< 20. EX
3111	320.	63.	71.	380.	3. EX	13. EX
3221	450.	90.	95.	500.	10. EX	20. EX
3241	300.	80.	90.	330.		
3291	343.	75.	80.	334.	67. EX	13. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 11: ALL DATA RECEIVED FOR CHROMIUM IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
3381	385.	60.	100.	435.	< 5. EX	< 5. EX
3521	360.	60.	70.	380.	7.	11.
3561	600.	300.	400.	800.	80.	100.
3741	690.	150.	220.	790.	22. EX	8. EX
3931	570.	390.	460.	750.	340.	80.
3971	400.	90.	110.	400.	0.	0.
4401	399.	92.	102.	496.	< 50.	< 50.
4411	465. CT	90. CT	110. CT	505. CT	10. CT	19. CT
4421	300.	53.	63.	333.	7. CT	10. CT
4431	420.	120.	120.	412.	21.5	60.
4451	160.	30.	80.	340.	10.	20.
4461	380.	50.	100.	400.	20.	20.
4471	236.	62.	57.	236.	4.7	25.
4491	290.	62.	68.	320.		
4501	320.	95.	1.	353.	7.	21.
4521				380.		
4551	350.	100.	<100.	400.	<100.	<100.
4561	380.	70.	100.	420.	< 10.	20.
4581	213.	75.	93.	268.	30.	40.
4591	10.	0.	0.	10.	0.	0.
4621	435. CT	94. CT	125. CT	385. CT	7. CT	15. CT
4641	402.	80.	95.	43.	14.	16.
4651	330.	60. EX	60. EX	310.	10. EX	10. EX
4671	260.	50.0	60.0	300.	10.	20.
4681	390.	80.	100.	410.	10.	20.
4701	426. DM	53. EX	78. EX	422.	10. EX	20. EX
4711	493.	130.	147.	512.	115.	0.
4721	387.	66.	127.	389.	24.	31.
4731	385.	85.	80.	395.		
4761	430.	80.	100.	480.	0.	40.
4771	350.	150.	60.	400.	7.5	18.
4781	98.0	14.0	2.0	86.0		
4791	330. EX	60. EX	80. EX	350. EX	6.0 EX	12. EX
4801	395.	78. EX	95. EX	403.	15. EX	22. EX
4811	324.	69.0	108.0	391.0	< 10.0	< 10.0
4821	380.	180.	180.	380.	<100.	<100.
4881	320.	35. EX	45. EX		6. EX	10. EX
4901	100.	107. EX	112. EX	220.	3. EX	15. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 11: ALL DATA RECEIVED FOR CHROMIUM IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4911	391.	71.	88.	425.	7.6	14.
4921	296. EX	61. EX	116. EX	350. EX	12. EX	22. EX
4922	350.	70.	86.	406.	24.	34.
4931	400. EX	83. EX	102. EX	450. EX	8.0 EX	16. EX
4941	540.00	170.00	120.00	520.00	0.0	0.0
4961	31. EX	15. EX	17. EX	33.0 EX	2.5 EX	3.6 EX
4971	320.	52.	70.	375.	< 40. EX	< 40. EX
4981	283.	76.	67.	289.	< 00.1 EX	< 00.1 EX
5001	320.	50.	80.	310.	< 50.	< 50.
5011	2100.			2450.		
5022	480. DM	120. DM	150. DM	410. DM	13. DM	18. DM
5031	345.	80.	85.	380.	6. CT	13. CT
5041	340.	80.	30.	340.	10.	30.
5061	370.	80.	95.	400.	8.0 EX	15. EX
5071	400.	90.	100.	480.	< 4. EX	< 4. EX
5181	370.	70.	70.	410.	10.	10.
5291	343.	76.	85.	390.	18.	25.
5371	0.37	.09	.09	.42		
5391		8. CT	14. CT	340. CT	70. CT	85. CT
5401	588.	84.	120.			
5501	413.	120.	170.	466.	11. EX	10. EX
5511	353.	70.	84.	380.	10.	20.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 12: ALL DATA RECEIVED FOR COPPER IN DISTILLED WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	272.	54.	67.	340.	7.0 EX	9.5 EX
1021	300.	63. CT	78. CT	300.	13. CT	19. CT
1031	306.	83.	87.	350.	18. EX	19. EX
1061	275. CT	57. CT	67. CT	295. CT	< 1. CT	13. CT
1091	370.	50.	70.	290.	15. EX	18. EX
1101	300.	70. CT	88. CT	350.	16. CT	22. CT
1111	285. CT	57. CT	74. CT	313. CT	10. CT	11. CT
1121	300.	55.	80.	335.	8. CT	10. CT
1131	293.	60.	73.	326.	7.	13.
1151	327.	136. EX	143. EX	365.	29. EX	21. EX
1161	304.	316.	56.	346.	6.	7.
1171		52.	58.		8.6	16.
1221	302.	55.	78.	330.		
1241	300.	64.	78.	328.	16.	18.
1301	300.	<100.	<100.	300.	<100.	<100.
1371	390. EX	100. EX	100. EX	460. EX	26.0 EX	33.0 EX
1381	280.	60.	70.	320.	1.2 EX	1.1 EX
1401	29. DM	11.9 DM	15.0 DM	32.4 DM	1.46DM	2.33DM
1451	318.	68. EX	82. EX	345.	12. EX	14. EX
1471	285.	80.	82.	310.	9.4 EX	4.4 EX
1481	270.	60.	66.	320.	13.	17.
1501	320.	80.	100.	330.	30.	40.
1521	279.	54.	68.	303.	9. EX	13. EX
1571	300.	60.	80.	340.	10.	20.
1681	320.	10.	10.	300.	50.	70.
1691	315.	80.	80.	380.	20.	30.
1701	304.	61.	77.	335.	8.6	12.
1901	298.	58.	75.	326.	7.	29.
1951	300.	50.	55.	300.	5. CT	10. CT
2041	340.	77.	93.	364.	8. EX	14. EX
2121	299.	62.	77.	329.	15.	21.
2301	314.	70.	68.	325.	< 15.	< 15.
2491	290.	20.	40.	320.	7. CT	13. CT
2501	280.	54.	69.	310.		
2521	390.	60.	70.	480.	11.	12.
2591	275. EX		69. EX	308. EX	10. EX	12. EX
2621	300.	50.	80.	320.	20.	< 10.
2671	330.	60.	90.	370.	9. EX	14. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 12: ALL DATA RECEIVED FOR COPPER IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
2721	5.7	1.8	2.0	6.5	1.5	1.1
2731	324.	60.	60.	350.		
2791	340.	53. EX	63. EX	295.	15. EX	14. EX
2821	293.	53.	70.	320.	7.5 EX	7.8 EX
2831	255. EX	102. EX	100. EX	310. EX	< 25. EX	< 25. EX
2911	350.	72.	86.	290.	38.	41.
3091	350.	80.	100.	380.	< 30.	< 30.
3111	270.	58.	71.	252.	7. EX	12. EX
3221	310.	80.	80.	310.	11.	24.
3241	250.	52.	66.	320.		
3291	310.	60.	85.	309.	2. EX	< 1. EX
3381	960.	780.	780.	960.	700.	700.
3521	300.	59.	74.	340.	14.	15.
3561	320.	150.	120.	350.	< 50. EX	70.
3741	320.	70.	70.	340.	10.	20.
3791	264. DM	58. DM	77. DM	351. DM	7.8 DM	12.3 DM
3931	32. EX	100. EX	110. EX	370. EX	100. EX	28. EX
3971	330.	60.	80.	360.	10.	0.
4021	280.	100.	110.	310.	70.	30.
4221	344. EX	67. EX	91. EX	378. EX	14. EX	19. EX
4401	311.	59.	71.	339.	< 50.	< 50.
4411	300. CT	60. CT	75. CT	325. CT	7.8 CT	13. CT
4421	270.	50.	62.	283.	16. CT	24. CT
4431	290.	120.	120.	332. CT	23. CT	35. CT
4441	365.	81.	10.	397.	88.	20.
4451	300.	60.	80.	280.	10.	10.
4461	280.	60.	70.	320.	6.5 EX	9.0 EX
4471	687.	129.	165.	779.	9.	20.
4481	460. EX	130. EX	150. EX	370. EX	20. EX	20. EX
4491	255.	50.	57.	280.		
4501	305.	115.	155.	362.	17.	26.5
4511	280. EX	68. EX		325. EX	8. EX	13. EX
4521	310.	40.	60.	340.		
4531	300. EX	58. EX	72. EX	320. EX	8. EX	12. EX
4541	1235.	260.	370.	1350.	20.	60.
4551	275.	110.	100.	300.	<100.	<100.
4561	310.	70.	80.	340.	10.	20.
4571	203.	36.	52.	203.	36.	51.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

TABLE 12: ALL DATA RECEIVED FOR COPPER IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4581	243.	42.	48.	261.	0.	0.
4601	266.	39.	64.	278.	< 25.	< 25.
4621	300. CT	60. CT	76. CT	328. CT	9. CT	13. CT
4631	19.	50.	62.	22.	2.0	1.0
4641	276.	50.	65.	303.	0.	11.
4651	290.	70.	80.	310.		
4661	300.	100.	100.	350.	50.	50.
4671	210.	25.	60.	250.	0.	0.
4681	300.	60.	80.	320.	< 10.	10.
4691	510.	100.	110.	500.		
4701	300.	60.	77.	321.	7.4 EX	13. EX
4711	310.	60.	120.	330.	0.	0.
4721	219.	45.	64.	250.	6.	0.3
4731	210.	40.	50.	250.		
4741	320.	115.	134.	380.	10.	15.
4751	300.	55.	60.	330.	9. EX	12. EX
4752					6. CT	10. CT
4761	390.	90.	90.	390.	20.	20.
4771	283.	60.	65.	295.	10.	10.
4781	517.5 EX	103.2 EX	126.2 EX	540.5 EX	20. EX	27.8 EX
4791	290. EX	60. EX	80. EX	300. EX	7.0 EX	10. EX
4801	301.	58. EX	70. EX	351.	9.2 EX	13. EX
4811	270.0	70.0	90.0	360.0	< 5.0	< 5.0
4821	365.	90.	90.	380.	< 20.	< 20.
4831	286.	68.	90.	296.	22.	22.
4841	320.	70.	90.	350.	10.	20.
4861	308.			337.		
4871	278.	40.	57.	311.	0.	10.
4881	315. EX	48. EX	56. EX	335. EX	15. EX	18. EX
4891	307.	60.	74.	334.	4.	11.
4901	464.	100.	100.	473.	35.	50.
4911	294.	60.	74.	323.	8.9	11.
4921	320.	51. EX	73. EX	350.	3. EX	2. EX
4931	300.	60. EX	76. EX	325.	8.0 EX	12. EX
4941	300.0	58.0	71.0	330.0	8.0	14.0
4961	30. EX	12. EX	15. EX	34. EX	1.8 EX	2.6 EX
4971	305.	72.	76.	350.	10. EX	4. EX
4981	300.	110.	75.	285.	8. EX	13. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 12: ALL DATA RECEIVED FOR COPPER IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4991	434.	59.	70.	395.	1.3 EX	1.1 EX
5001	320.	50.	70.	320.	< 20.	< 20.
5011	3000.	1250.	1550.	3400.	175.	250.
5021	290. DM	76. DM	74. DM	310. DM	13. DM	21. DM
5031	275.	55.	70.	315.	13. CT	18. CT
5041	290.	63.	81.	334.	21.	16.
5061	280.	55.	70.	300.	7.0 EX	11. EX
5071	330.0	80.0	100.0	360.0	7.0 EX	10.0 EX
5181	300.	50.	60.	340.	10.	20.
5291	300.	57.	70.	310.	10.	15.
5371	.27	.06	.08	.30	.04	
5391	350.	12. CT	37. CT	310.	68. CT	80. CT
5401	210.	48.	58.			
5501	300.	50.	76.	330.	10. EX	12. EX
5511	296.	58.	79.	329.	8.4 EX	15. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 13: ALL DATA RECEIVED FOR COPPER IN NATURAL WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	275.	58.	70.	320.	6.9 EX	8.9 EX
1021	320.	49. CT	62. CT	320.		9. CT
1031	306.	40.	79.	320.	2.0 EX	< 1.0 EX
1061	263. CT	47. CT	65. CT	303. CT	6. CT	9. CT
1091	290.	50.	70.	290.	16. EX	17. EX
1101	300.	70. CT	75. CT	340.	10. CT	17. CT
1111	269. CT	52. CT	64. CT	268. CT	3. CT	6. CT
1121	300.	60.	75.	330.	8. CT	11. CT
1131	293.	60.	73.	324.	6.	12.
1151	274.	126. EX	136. EX	323.	30. EX	9. EX
1161	314.	356.	58.	350.	4.	8.
1171	288.	62.	70.	246.	12.	17.
1221	300.	55.	75.	330.		
1241	229.	36.	57.	258.	0.0	0.0
1371	280. EX	82.0 EX	67.0 EX	280. EX	17.0 EX	26.0 EX
1381	270.	50.	60.	310.	1.0 EX	2.0 EX
1451	318.	62. EX	73. EX	345.	8. EX	9. EX
1471	282.	72.	76.	310.	6.2 EX	12. EX
1501	300.			330.		
1521	280.	55.	70.	306.	9. EX	13. EX
1571	330.	70.	80.	340.	10.	20.
1701	302.	59.	76.	322.	7.2	11.
1901	291.	56.	68.	324.	6.	0.
2041	344.	68.	132.	373.	13. EX	17. EX
2121	293.	62.	82.	340.	15.	26.
2301	308.	61.	70.	336.	< 15.	< 15.
2491	290.	20.	40.	320.	6. CT	9. CT
2501	252.	44.	71.	277.	8.	14.
2521	385.	55.	65.	475.	11.	10.
2591	276. EX	64. EX	72. EX	309. EX	11. EX	12. EX
2621	300.	50.	100.	340.	10.	20.
2671	330.	70.	90.	370.	11. EX	15. EX
2731	324.	60.	60.	350.		
2791	310.	50. EX	63. EX	300.	10. EX	10. EX
2821	292.	56.	71.	320.	5.7 EX	9.7 EX
2831	260. EX	113. EX	120. EX	302. EX	< 25. EX	< 25. EX
3091	340.	100.	120.	390.	< 30.	< 30.
3111	263.	54.	74.	260.	7. EX	13. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 13: ALL DATA RECEIVED FOR COPPER IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
3221	308.	78.	78.	286.	10.	20.
3241	280.	50.	75.	310.		
3291	282.	44.	65.	313.	10. EX	< 1. EX
3381	440.	170.	170.	480.	14.5 EX	44.5 EX
3521	300.	65.	80.	330.	11.	17.
3561	360.	220.	190.	470.	< 50. EX	80.
3741	330.	60.	80.	360.	10.	10.
3931	27. EX	70. EX	80. EX	310. EX	11. EX	15. EX
3971	330.	60.	80.	360.	10.	0.
4021	330.	90.	110.	350.	50.	40.
4221	332. EX	75. EX	87. EX	369. EX	13. EX	18. EX
4401	289.	55.	66.	322.	< 50.	< 50.
4411	298. CT	62. CT	77. CT	330. CT	8.1 CT	13. CT
4421	207.	45.	49.	244.	6. CT	7. CT
4431	320.	130.	130.	375. CT	15. CT	29. CT
4451	300.	60.	60.	270.	< 10.	10.
4461	280.	60.	80.	320.	4.5 EX	8.5 EX
4471	635.	125.	160.	682.	37.	28.
4481	420. EX	120. FX	150. EX	320. EX	20. EX	20. EX
4491	255.	50.	60.	280.		
4501	362.	98.	155.	363.	15.	27.5
4511	275. EX	57. EX		315. EX	12. EX	12. EX
4521				320.		
4541	1240.	270.	320.	1430.		95.
4551	275.	100.	<100.	320.	<100.	<100.
4561	300.	70.	80.	340.	10.	20.
4571	205.	37.	52.	205.	37.	53.
4581	238.	42.	41.	255.	1.	11.
4601	291.	64.	77.	303.	< 25.	< 25.
4621	278. CT	54. CT	71. CT	332. CT	8. CT	12. CT
4631	20.	50.	62.	22.	2.5	2.0
4641	288.	63.	74.	320.	11.	26.
4651	290.	70.	80.	310.	10.	
4661	300.	50.	50.	300.	30.	30.
4671	224.	50.	75.	224.	0.	0.
4681	300.	60.	70.	320.	< 10.	10.
4691	530.	120.	130.	520.		
4701	296.	67.	67.	331.	7.0 EX	9.6 EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 13: ALL DATA RECEIVED FOR COPPER IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4711	290.	50.	90.	200.	10.	0.
4721	225.	39.	59.	258.	2.	0.2
4731	170.	55.	65.	190.		
4751					12. EX	15. EX
4761	390.	90.	90.	390.	20.	30.
4771	283.	60.	65.	285.	9.5	9.5
4781	469.7 EX	65.2 EX	110.0 EX	515.7 EX		
4791	290. EX	60. EX	80. EX	300. EX	7.0 EX	10. EX
4801	304.	61. EX	74. EX	355.	13. EX	17. EX
4811	255.0	55.0	55.0	274.0	< 5.0	< 5.0
4821	315.	70.	80.	315.	< 40.	< 40.
4861	308.			337.		
4881	324. EX	47. EX	55. EX	331. EX	11. EX	20. EX
4891	305.	58.	78.	338.	7.	9.
4901	392.	117.	100.	445.	50.	56.
4911	297.	60.	75.	329.	8.9	13.
4921	290.	60. EX	73. EX	338.	8. EX	7. EX
4931	300.	60. EX	76. EX	330.	10. EX	11. EX
4941	300.0	59.0	76.0	330.0	0.	0.
4961	30. EX	10. EX	16. EX	34.0 EX	2.0 EX	2.8 EX
4971	320.	62.	81.	340.	10. EX	7. EX
4981	300.	80.	75.	290.	13. EX	16. EX
4991	356.	56.	77.	382.	1.1 EX	1.2 EX
5001	300.	50.	70.	320.	< 20.	< 20.
5011	3000.			3400.		
5031	280.	60.	70.	300.	7. CT	13. CT
5041	302.	84.	76.	279.	17.	22.
5061	280.	55.	70.	300.	7.0 EX	11. EX
5071	330.0	80.0	100.0	360.0	7.0 EX	10.0 EX
5181	300.	50.	70.	320.	10.	0.
5291	300.	57.	70.	314.	10.	15.
5371	.14	- .03	- .01	.17	- .03	
5391		10. CT	14. CT	310. CT	60. CT	80. CT
5401	237.	77.	88.			
5501	290.	52.	68.	322.	8. EX	7. EX
5511	301.	62.	77.	326.	7.7 EX	13. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 14: ALL DATA RECEIVED FOR IRON IN DISTILLED WATER, UG/L

LAB/ ANALYST	SAMPLE 1		SAMPLE 2		SAMPLE 3		SAMPLE 4		SAMPLE 5		SAMPLE 6	
1011	850.		390.		440.		720.		18.	EX	10.	EX
1021	1000.		58.		94.		1000.		75.		100.	
1031	740.		340.		400.		610.		48.		54.	
1061	828.	CT	321.	CT	443.	CT	686.	CT	47.	CT	21.	CT
1091	6700.		3300.		4200.		6000.		400.		200.	
1101	860.		380.	CT	450.	CT	720.		31.	CT	15.	CT
1111	850.	CT	330.	CT	430.	CT	700.	CT	20.	CT	10.	CT
1121	750.		270.		400.		640.		46.	CT	30.	CT
1131	837.		355.		426.		697.		26.		13.	
1151	874.		399.		482.		734.		37.	EX	19.	EX
1171			370.		494.				173.		176.	
1221	850.		357.		440.		672.					
1301	800.		400.		500.		700.		<100.		<100.	
1371	1000.		200.		240.		500.		180.		200.	
1401	97.	DM	72.	DM	88.	DM	59.	DM	4.6	DM	1.8	DM
1451	840.		350.		430.		700.		30.		10.	
1481	720.		350.		420.		670.		38.		< 10.	
1501	860.		370.		420.		720.		60.		30.	
1521	784.		314.		406.		651.		25.		12.	
1571	850.		350.		430.		680.		20.		10.	
1681	660.						850.		360.		420.	
1691	810.		375.		440.		640.		80.		60.	
1701	826.		369.		446.		698.		19.		7.4	
1901	851.		348.		438.		709.		26.		23.	
1951	800.		300.		400.		620.		0.		0.	
2041	914.		288.		397.		745.		22.	EX	12.	EX
2121	784.		314.		388.		660.		33.		8.3	
2301	842.		1320.		521.		740.		< 25.		< 25.	
2491	910.		390.		500.		840.		45.	CT	36.	CT
2501	830.		330.		420.		680.					
2521	830.		400.		430.		730.		< 30.		< 30.	
2591	830.				445.	EX	680.		30.	EX	16.	EX
2621	890.		350.		490.		700.		< 50.		< 50.	
2671	850.		360.		420.		720.		32.	EX	39.	EX
2721	660.		260.		320.		650.		125.		50.	
2731	844.		325.		491.		719.					
2791	960.		590.		410.		680.		115.	EX	40.	EX
2821	821.		329.		412.		694.		174.		13.	EX
2911	812.		343.		375.		531.		133.		66.	
3091	830.		350.		410.		680.		80.		< 50.	
3221	890,		350.		440.		800.		30.		30.	

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

TABLE 14: ALL DATA RECEIVED FOR IRON IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
3241	810.	400.	360.	690.		
3291	783.	290.	408.	658.	378. EX	48. EX
3381	890.	350.	450.	740.	37. EX	18. EX
3521	720.	310.	380.	590.	27.	14.
3561	1100.	1500.	1000.	1000.	300.	< 50. EX
3741	830.	350.	440.	710.		
3791	878. DM	341. DM	429. DM	806. DM	25.8 DM	11.3 DM
3931	720. EX	390. EX	440. EX	651. EX	43. EX	15. EX
3971	850.	350.	420.	700.	10.	0.
4021	780.	450.	470.	750.	70.	70.
4221	1139.	315.	412.	954.	45.	28.
4401	831.	352.	431.	678.	< 50.	< 50.
4411	850. CT	300. CT	400. CT	700. CT	25. CT	10. CT
4421	747.	310.	382.	617.	29. CT	19. CT
4431	740.	280.	340.	710.	250.	200.
4441	1020.	415.	545.	798.	50.	47.
4461	770.	330.	400.	660.	19. EX	5. EX
4471	710.	280.	379.	627.	10.	4.
4481	1200. EX	500. EX	630. EX	810. EX	30. EX	20. EX
4491	730.	290.	380.	570.		
4501	815.	583.	860.	658.	49.1	22.
4511	715. EX	294. EX		645. EX	30. EX	23. EX
4521	840.	330.	400.	740.		
4531	840. EX	390. EX	500. EX	730. EX	40. EX	56. EX
4551	900.	450.	550.	770.	<100.	<100.
4561	960.	420.	500.	790.	< 10.	50.
4571	69. EX	24. EX	37. EX	69. EX	23. EX	36. EX
4581	699.	362.	461.	666.	64.	42.
4591	640.	510.	640.	500.	0.	0.
4601	860. DM	350. DM	430. DM	700. DM	80. DM	60. DM
4621	929. CT	346. CT	439. CT	716. CT	67. CT	40. CT
4631	788.	341.	422.	670.	20.	< 20.
4641	825.	337.	411.	667.	0.	30.
4651	840.	310.	470.	690.		
4661	280. EX	160. EX	180. EX	280. EX	60. EX	60. EX
4671	620.	250.	320.0	450.0	0.	0.
4681	870.	360.	440.	670.	30.	20.
4691	1000.	480.	650.	980.	100.	
4701	845. DM	410. DM	432. DM	657.	22. EX	11. EX
4711	1000.	430.	480.	760.	0.	0.
4721	813.	339.	434.	698.	29.	8.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 14: ALL DATA RECEIVED FOR IRON IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4731	980.	370.	400.	740.		
4741	888.	600.	938.	650.	94.	65.
4751	600.	260.	330.	500.	20. EX	11. EX
4752					18. CT	9. CT
4761	980.	420.	530.	810.	60.	40.
4771	825.	350.	700.	700.	76.	76.
4781	645.0 EX	528.0 EX	594.0 EX	625.0 EX	50.0 EX	38.0 EX
4791	800. EX	330. EX	350. EX	700. EX	25. EX	10. EX
4801	901.	300.	450.	700.	30. EX	16. EX
4811	737.0 EX	368.0 EX	447.0 EX	697.0 EX	39.0 EX	13.0 EX
4821	760.	314.	430.	620.	< 40.	< 40.
4831	492.	246.	369.	554.	19.	19.
4841	820.	340.	420.	680.	20.	0.
4851	853.	356.	436.	677.		
4861	759.			689.		
4871	912.	323.	399.	722.	16.	- 3.
4881	605.	305. EX	383. EX	542.	29. EX	16. EX
4891	850.	344.	428.	697.	22.	4.
4901	860.	385.	418.	730.	36. EX	23. EX
4911	828.	350.	430.	693.	29.	10.
4921	792.	366.	436.	732.	34. EX	37. EX
4931	830. DM	380. DM	450. DM	720. DM	22. EX	10. EX
4941	900.0	400.0	400.0	700.0	0.	0.
4961	64. EX	55. EX	65. EX	56. EX	5.5 EX	2.9 EX
4971	710.	260.	400.	670.	11. EX	30. EX
4981	810.	500.	475.	687.	60. EX	79. EX
4991	829.	419.	483.	682.	2.8 EX	1.7 EX
5001	810.	310.	420.	670.	< 10.	< 10.
5011	7800.	5900.	8000.	6200.	600.	350.
5022	1230. DM		780. DM	1230. DM	48. DM	30. DM
5031	800.	290.	385.	566.	50. CT	36. CT
5041	590.	60.	140.	450.	0.0	0.0
5061	850.	360.	450.	700.	29. EX	16. EX
5071	900.0	400.0	450.0	700.0	50.0	60.0
5181	700.	200.	400.	600.	100.	0.
5291	900.	342.	440.	706.	16.	6.0
5371	0.80	0.22	0.42	0.67		
5391	700.	37. CT	35. CT	830.	360. CT	530. CT
5401	1029.	564.	686.			
5501	883.	385.	466.	735.	38. EX	19. EX
5511	845.	379.	494.	712.	28. EX	9.5 EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 15: ALL DATA RECEIVED FOR IRON IN NATURAL WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	790.	250.	390.	550.		
1021	1200.	60.	80.	1200.		
1031	717.	340.	415.	660.	49.	49.
1061	872. CT	365. CT	467. CT	710. CT		
1091	6100.	2400.	4100.	5800.	200.	200.
1101	750.	300. CT	400. CT	600.	0. CT	0. CT
1111	880. CT	340. CT	460. CT	710. CT	20. CT	10. CT
1121	850.	370.	430.	710.		
1131	830.	450.	420.	660.	10.	10.
1151	859.	535.	467.	704.	40. EX	27. EX
1171	960.	628.	421.	786.	170.	209.
1221	830.	351.	425.	673.		
1371	1000.	200.	350.	460.	<100.	140.
1451	840.	360.	440.	720.	30.	10.
1501	850.			720.		
1521	790.	315.	415.	658.	41.	30.
1571	850.	330.	390.	690.	20.	10.
1701	843.	380.	452.	737.	55.	60.
1901	848.	352.	435.	704.	30.	14.
2041	956.	334.	443.	785.	32. EX	24. EX
2121	743.	322.	404.	644.	25.	0.
2301	834.	556.	504.	684.	< 25.	< 25.
2491	900.	400.	490.	830.	25. CT	15. CT
2501	910.	450.	450.	715.	90.	50.
2521	730.	290.	390.	640.	40.	0.
2591	820.	342. EX	445. EX	680.	30. EX	
2621	920.	360.	470.	730.	< 50.	< 50.
2671	900.	360.	440.	700.	40. EX	44. EX
2731	759.	317.	325.	647.		
2791	1200.	390.	730.	560.	80.	80.
2821	849.	368.	479.	710.	170.	55. EX
3091	980.	440.	540.	830.	130.	60.
3221	900.	360.	440.	800.	40.	40.
3241	910.	390.	400.	690.		
3291	900.	367.	516.	746.	96. EX	399.
3381	890.	350.	450.	740.	48. EX	80. EX
3521	770.	320.	390.	590.	28.	17.
3561	1100.	1300.	1100.	1000.	200.	< 50. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 15: ALL DATA RECEIVED FOR IRON IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
3741	830.	340.	430.	690.		
3931	645. EX	420. EX	470. EX	650. EX	93. EX	27. EX
3971	780.	310.	380.	700.	50.	0.
4021	830.	400.	440.	710.	60.	60.
4221	1212.	312.	549.	826.	100.	118.
4401	838.	350.	507.	747.	27.	25.
4411	868. CT	314. CT	398. CT	690. CT	27. CT	9.6 CT
4421	819.	297.	382.	615.	10. CT	0. CT
4431	2440.	1890.	2080.	2000.	1500.	1635.
4461	820.	320.	700.	600.		
4471	604.	255.	353.	502.	34.	105.
4481	1120. EX	610. EX	720. EX	680. EX		20. EX
4491	740.	280.	360.	600.		
4501	815.	577.	991.	682.	49.	32.
4511	665. EX	280. EX		620. EX	29. EX	24. EX
4521				760.		
4551	900.	425.	450.	900.	<100.	<100.
4561	890.	390.	490.	760.	< 10.	< 10.
4571	70. EX	26. EX	38. EX	71. EX	25. EX	37. EX
4581	1107.	654.	726.	983.	296.	374.
4591	570.	510.	560.	520.	0.	10.
4601	1310. DM	880. DM	105. DM	1370. DM	600. DM	600. DM
4621	744. CT	277. CT	441. CT	706. CT	14. CT	19. CT
4631	796.	342.	424.	670.	21.	
4641	1010.	518.	600.	855.	187.	208.
4651	820.	350.	460.	690.	20.	10.
4661	290. EX	120. EX	160. EX	270. EX	65. EX	75. EX
4671	600.	230.	330.	450.0	0.	0.
4681	840.	350.	440.	690.	40.	30.
4691	1050.	500.	690.	1000.	110.	
4701	877. DM	440. DM	470. DM	667.	22. EX	12. EX
4711	970.	540.	490.	770.	0.	0.
4721	824.	330.	432.	694.	24.	15.
4731	990.	380.	480.	780.		
4761	1460.	950.	1170.	124.	780.	600.
4771	600.	75.	100.	450.		
4781	485.0 EX	394.0 EX	544.0 EX	600.0 EX		
4791	800. EX	330. EX	350. EX	700. EX	25. EX	10. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 15: ALL DATA RECEIVED FOR IRON IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4801	1255.	702.	851.	1002.	332.	331.
4811	744.0 EX	410.0 EX	487.0 EX	744.0 EX	34.0 EX	60.0 E
4821	865.	330.	464.	710.	< 40.	< 40.
4851	900.	416.	479.	770.		
4861	759.			675.		
4881		321. EX	374. EX	533.	20. EX	
4891	865.	370.	445.	700.	23.	15.
4901	835.	387.	463.	995.	56. EX	51. EX
4911	832.	352.	435.	694.	37.	17.
4921	702.	320.	386.	623.	0. EX	0. EX
4931	850. DM	370. DM	450. DM	730. DM	22. EX	10. EX
4941	1400.	1000.	1100.	1400.	600.0	600.0
4961	61. EX	53. EX	60. EX	57. EX	5.3 EX	3.1 EX
4971	870.	270.	320.	760.	16. EX	54. EX
4981	825.	555.	565.	738.	83. EX	74. EX
4991	811.	411.	485.	694.	2.0 EX	.9 EX
5001	830.	320.	410.	670.	< 10.	< 10.
5011	7500.			6400.		
5022	1370. DM	610. DM	810. DM	1250. DM	120. DM	95. DM
5031	736.	276.	326.	531.	41. CT	22. CT
5041	930.	53.	0.0	800.	250.	0.0
5061	850.	360.	450.	690.	29. EX	16. EX
5071	800.0	300.0	420.0	670.0	30.0	45.0
5181	1000.	400.	400.	800.	100.	0.
5291	875.	340.	440.	710.	20.	6.0
5371	0.86	0.28	0.43	0.73		
5391		30. CT	100. CT	880.	380.	480.
5401	1020.	410.	745.			
5501	798.	333.	423.	685.	17. EX	21. EX
5511	858.	391.	502.	729.	30. EX	11. EX

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DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 16: ALL DATA RECEIVED FOR LEAD IN DISTILLED WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	385.	122. EX	95. EX	325.	33. EX	32. EX
1012	364. SB	119. SB	92. SB	348. SB	52. SB	30. SB
1021	370. CT	110. CT	90. CT	350. CT	50. CT	30. CT
1031	578.			520.		
1061	317. CT	83. CT	58. CT	307. CT	35. CT	25. CT
1091	300.	50.	70.	280.	37. EX	30. EX
1111	350. CT	100. CT	90. CT	320. CT	50. CT	40. CT
1121	310.	100.	100.	290.	36. CT	26. CT
1131	350.	90.	70.	320.	40.	20.
1151	396. EX	68. EX	56. EX	183. EX	50. EX	32. EX
1161	425.	99.	53.	356.	< 30.	< 30.
1171		69.	51.		19.	12.
1221	395.	130.	135.	363.		
1241	387.	100.	83.	326.	50.	26.
1301	<500.	<500.	<500.	<500.	<500.	<500.
1371	760.	150.	130.	870.	20.0	35.0
1381	400.	100.	100.	300.	4.3 EX	3.0 EX
1401	36.0 DM	20.0 DM	14.6 DM	33.0 DM	7.50DM	14.6 DM
1451	325.	71. EX	82. EX	370.	35. EX	24. EX
1471	285. EX	82. EX	62. EX	275. EX	38. EX	25. EX
1501	280.	120. EX	100. EX	300. EX	30. EX	30. EX
1521	420.	100. EX	88. EX	355.	35. EX	16. EX
1571	400.	93.	70.	290.	39.	21.
1681	370. EX	70. EX	50. EX	400. EX	140. EX	90. EX
1691	51. DM	44. DM	38. DM	45. DM	32. DM	35. DM
1901	385.	145.	110.	345.	21. EX	20. EX
1951	400. EX	110. EX	72. EX	325. EX	37. EX	27. EX
2041	415.	82.	150.	361.	62.	43. EX
2121	340.	101.	82.	302.	12.	19.
2301	400.	<150.	<150.	350.	<150.	<150.
2491	280.	100.	85.	300.	41. CT	23. CT
2501	380.	170.		340.		
2521	500.	134.	104.	500.	46.	29.
2591	365. EX		73. EX	328. EX	33. EX	21. EX
2621	860. EX	128. EX	88. EX	740. EX	25. EX	45. EX
2671	350.	110.	130.	280.	36. EX	23. EX
2721	12.5 EX	1.85EX	0.9 EX	2.9 EX	0.9 EX	0.6 EX
2731				360.		
2791	370. EX	80. EX	81. EX	320. EX	85. EX	35. EX
2821	341.	93. EX	82. EX	325.	34. EX	22. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 16: ALL DATA RECEIVED FOR LEAD IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
2791	370. EX	80. EX	81. EX	320. EX	85. EX	35. EX
2821	341.	93. EX	82. EX	325.	34. EX	22. EX
2911	391.	200.	125.	326.	150.	100.
3091	410.	<100.	<100.	260.	<100.	<100.
3111	30. EX	17. EX	14. EX	67.	9. EX	6. EX
3221	400.	94.	94.	400.	47. EX	34.5 EX
3291	438.	< 2. EX	39. EX	514.	25. EX	21. EX
3381	350.	130.	130.	310.	33. EX	34.5 EX
3521	350.	82.	65.	310.	28.	24.
3561	500. SB	240. SB	200. SB	680. SB	60. SB	40. SB
3741	400.	90.	90.	390.	10.	
3791	374. DM	98. DM	84. DM	370. DM	40. DM	38. DM
3931	296. EX	80. EX	63. EX	267. EX	37. EX	13. EX
3971	500.	0.	0.	200.	0.	0.
4221	337. EX	62. EX	36. EX	297. EX	0. EX	0. EX
4401	343.	<200.	<200.	348.	<200.	<200.
4411	400. CT	119. CT	100. CT	400. CT	45. CT	29. CT
4421	273.	50.	50.	220.	21. CT	9. CT
4431	360. CT	160. CT	80. CT	308. CT	60. CT	47. CT
4441	465.	140.	140.	420.	< 50.	< 50.
4451	380.	110.	90.	330.	60.	30.
4461	300.	100. EX	84. EX	400.	41. EX	27. EX
4472	310. EX	100. EX	85. EX	290. EX	45. EX	33. EX
4481	540. EX	120. EX	100. EX	420. EX	50. EX	50. EX
4501	50. EX	20. EX	18. EX	42. EX	11. EX	8.2 EX
4511	405. EX	122. EX		410. EX	45. EX	29. EX
4521	365. SB	102. SB	84. SB	337. SB	37. SB	24. SB
4531	1760. EX	140. EX	108. EX	450. EX	52. EX	40. EX
4551	400.	<400.	<400.	450.	<400.	<400.
4561	410.	120.	100.	390.	80.	60.
4571	314.	391.	125.	314.	391.	126.
4581	466.	95.	111.	74.	90.	92.
4601	364.	84.	27.	309.	84.	27.
4621	377. CT	104. CT	86. CT	333. CT	36. CT	24. CT
4631	372.	93.	65.	295.		
4641	373.	73.	103.	326.	0.	5.
4651	950.	480.	240.	710.	380.	280.
4661	320. EX	90. EX	80. EX	260. EX	32. EX	22. EX
4671	322.0	25.0	25.	255.0	0.	0.
4681	450. EX	150. EX	134. EX	450. EX	52. EX	32. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 16: ALL DATA RECEIVED FOR LEAD IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4691	550.			500.		
4701	345.	143. EX	111. EX	254.	52. EX	22. EX
4711	540. EX	150. EX	90. EX	450. EX	30. EX	30. EX
4721	451.	160.	155.	402.	91.	45.
4731	410.			291.		
4741	450.	200.	190.	400.	10.	5.5
4751	350.	100.	75.	375.	26. EX	19. EX
4752					35. CT	25. CT
4761	640.	50.	540.	370.	120.	290.
4771	289.	55.	40.	220.	25.	23.
4781	570.0 EX	170.0 EX	140.0 EX	584.0 EX	62.0 EX	36.0 EX
4791	350. EX	100. EX	60. EX	300. EX	35. EX	25. EX
4801	352.	111. EX	100. EX	320.	36. EX	28. EX
4811	348.0	120.0	99.0	340.0	49.0	32.0
4821	400.	100.	100.	370.	100.	<100.
4831	380.	142.	142.	333.	47.	47.
4841	400.	100.	100.	300.	0.	0.
4881	446. EX	155. EX	135. EX	391. EX	66. EX	54. EX
4891	362.	125.	96.	346.	29.	15.
4901	630.	290.	240.	500.	210.	135.
4921	350.	92. EX	72. EX	380.	24. EX	14. EX
4931	375. EX	100. EX	84. EX	350. EX	38. EX	25. EX
4941	436.0 DM	112.0 DM	64.0 DM	332.0 DM	96.0 DM	64.0 DM
4961	37.0 EX	21. EX	17. EX	34. EX	8.0 EX	5.8 EX
4971	330.	60. EX	120.	310.	< 5. EX	15. EX
4981	420. EX	125. EX	125. EX	375. EX	70. EX	75. EX
4991	83. EX	52. EX	25. EX	79. EX	8.7 EX	6.6 EX
5001	340. SB	78. SB	71. SB	290. SB	46. SB	< 20. SB
5011	3500.	1850.	1600.	1650.	900.	400.
5031	400.	104. CT	79. CT	310.	39. CT	28. CT
5041	330.	0.0	0.0	250.	0.0	0.0
5061	370.	110.	86. EX	340.	34. EX	27. EX
5071	500.	10. EX	< 10. EX	460.	< 10.	< 10.
5181	340.	55.	40.	120.	15.	10.
5291	360.	113.	90.	350.	40.	30.
5371	0.48			0.31		
5391	310.	35. CT	30. CT	380.	97. CT	81. CT
5401	418.	147.	129.			
5501	333.	150.	115.	330.	31. EX	22. EX
5511	359.	85.	91. EX	319.	35. EX	23. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 17: ALL DATA RECEIVED FOR LEAD IN NATURAL WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	370.	118. EX	94. EX	350.	37. EX	26. EX
1012	396. SB	124. SB	90. SB	426. SB	60. SB	25. SB
1021	360. CT	100. CT	90. CT	330. CT	30. CT	20. CT
1031	580.			530.		
1061	359. CT	101. CT	81. CT	322. CT	35. CT	23. CT
1091	270.	30.	50.	270.	37. EX	30. EX
1111	360. CT	100. CT	90. CT	330. CT	40. CT	30. CT
1121	330.	100.	100.	310.	32. CT	23. CT
1131	350.	90.	70.	320.	40.	20.
1151	392. EX	87. EX	73. EX	286. EX	41. EX	12. EX
1161	420.	103.	60.	376.	< 30.	< 30.
1171	391.	74.	63.	245.	25.	13.
1221	370.	112.	115.	350.		
1241	331.	91.	95.	283.	41.	41.
1371	650.	120.	120.	500.	25.0	35.0
1381	400.	100.	100.	300.	9.8 EX	9.8 EX
1451	345.	69. EX	81. EX	340.	33. EX	25. EX
1471	287. EX	87. EX	72. EX	270. EX	41. EX	38. EX
1521	410.	100. EX	88. EX	360.	31. EX	20. EX
1571	420.	100.	73.	330.	35.	23.
1901	378.	132.	107.	352.	21. EX	20. EX
2041	420.	82.	142.	372.	66. EX	45. EX
2121	353.	101.	76.	302.	12.	19.
2301	400.	<150.	<150.	350.	<150.	<150.
2491	280.	100.	85.	350.	41. CT	23. CT
2501	370.	135.	115.	285.	80.	50.
2521	486.	108.	90.	486.	39.	21.
2591	366. EX	93. EX	73. EX	339. EX	33. EX	21. EX
2621	890. EX	131. EX	102. EX	810. EX	38. EX	48. EX
2671	360.	170.	80.	350.	37. EX	23. EX
2731				500.		
2791	380. EX	60. EX	60. EX	300. EX	80. EX	35. EX
2821	350.	99. EX	80. EX	325.	39. EX	26. EX
3091	410.	<100.	<100.	260.	<100.	<100.
3111	30. EX	17. EX	13. EX	69.	8. EX	6. EX
3221	400.	94.	94.	400.	47. EX	34.5 EX
3291	488.	< 2. EX	39. EX	488.	46. EX	12. EX
3381	350.	130.	130.	310.	38. EX	43.5 EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 17: ALL DATA RECEIVED FOR LEAD IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
3521	350.	84.	69.	310.	32.	22.
3561	400. SB	240. SB	200. SB	440. SB	100. SB	40. SB
3741	420.	100.	100.	420.	20.	
3931	306. EX	86. EX	73. EX	269. EX	43. EX	20. EX
3971	500.	0.	0.	300.	0.	0.
4221	336. EX	102. EX	31. EX	304. EX	0. EX	5. EX
4401	390.	<200.	<200.	395.	<200.	<200.
4411	398. CT	120. CT	105. CT	413. CT	47. CT	30. CT
4421	183.	33.	23.	150.	14. CT	10. CT
4431	420. CT	160. CT	90. CT	310. CT	75. CT	60. CT
4451	250.	110.	80.	350.	50.	30.
4461	300.	81. EX	66. EX	400.	25. EX	7.0 EX
4472	277. EX	92. EX	70. EX	242. EX	27. EX	17. EX
4481	570. EX	100. EX	100. EX	350. EX	50. EX	50. EX
4501	50. EX	19. EX	17. EX	39. EX	9. EX	7.4 EX
4511	415. EX	122. EX		425. EX	45. EX	29. EX
4521				355. SB		
4551	400.	<400.	<400.	460.	<400.	<400.
4561	430.	130.	140.	380.	90.	70.
4571	322.	390.	127.	320.	395.	128.
4581	490.	97.	110.	65.	91.	91.
4601	420.	253.	197.	475.	187.	140.
4621	353. CT	103. CT	87. CT	346. CT	46. CT	24. CT
4631	372.	98.	68.	300.		
4641	397.	110.	154.	419.	65.	88.
4651	950.			860.	240.	100.
4661	300. EX	85. EX	90. EX	300. EX	25. EX	25. EX
4671	230.0	110.0	100.	370.0	60.0	60.0
4681	610. EX	135. EX	150. EX	520. EX	58. EX	42. EX
4691	560.			550.		
4701	352.	131. EX	111. EX	260.	42. EX	20. EX
4711	480. EX	170. EX	44. EX	490. EX	50. EX	30. EX
4721	454.	160.	148.	402.	101.	35.
4731	370.			300.		
4751					25. EX	15. EX
4761	680.	430.	540.	410.	210.	330.
4771	342.	53.	35.	200.	25.	20.
4781	573.0 EX	156.0 EX	140.0 EX	572.0 EX	62.0 EX	34.0 EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 17: ALL DATA RECEIVED FOR LEAD IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4791	350. EX	100. EX	60. EX	300. EX	35. EX	25. EX
4801	363.	119. EX	109. EX	328.	54. EX	46. EX
4811	357.0	128.0	95.0	330.0	46.0	33.0
4821	320.	100.	100.	400.	130.	<100.
4881	442. EX	154. EX	130. EX	387. EX	65. EX	53. EX
4891	408.	86.	108.	356.	56.	29.
4901	740.	235.	220.	550.	235.	70.
4921	350.	105. EX	75. EX	322.	22. EX	16. EX
4931	375. EX	94. EX	84. EX	360. EX	39. EX	25. EX
4941	456.0 DM	144.0 DM	108.0 DM	380.0 DM	52.0 DM	64.0 DM
4961	32.0 EX	18.0 EX	14.0 EX	32.0 EX	7.5 EX	6.0 EX
4971	360.	90. EX	90.	340.	< 5. EX	10. EX
4981	380. EX	115. EX	120. EX	370. EX	70. EX	60. EX
4991	83. EX	52. EX	25. EX	79. EX	8.7 EX	6.6 EX
5001	310. SB	80. SB	80. SB	300. SB	41. SB	28. SB
5011	3500.			1650.		
5031	410.	92. CT	86. CT	335.	32. CT	23. CT
5041	270.	0.0	0.0	140.	50.	70.
5061	370.	110.	88. EX	340.	38. EX	27. EX
5071	500.	10. EX	< 10. EX	460.	< 10.	< 10.
5181	380.	75.	40.	140.	10.	10.
5291	360.	110.	87.	360.	40.	30.
5371	0.48			0.31		
5391		35. CT	30. CT	350.	80. CT	75. CT
5401	517.	194.	183.			
5501	326.	113.	95.	346.	31. EX	22. EX
5511	349.	75.	91. EX	313.	34. EX	27. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 18: ALL DATA RECEIVED FOR MANGANESE IN DISTILLED WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	408.	82.	105.	447.	9.0	12.
1021	400.	100.	100.	440.	11. CT	17. CT
1031	767.	99.	140.	873.	27.	27.
1061	445. CT	84. CT	104. CT	485. CT	12. CT	18. CT
1101	600.	110. CT	130. CT	620.	16. CT	24. CT
1111	396. CT	79. CT	98. CT	432. CT	12. CT	16. CT
1121	450.	100.	120.	490.	12. CT	16. CT
1131	428.	85.	107.	469.	12.	18.
1151	437.	84.	107.	505.	15.	21.
1171		79.	102.		11.	19.
1221	405.	75.	105.	448.		
1241	394.	78.	94.	430.	12.	16.
1301	430.	80.	90.	450.	< 20.	< 20.
1371	420.	88.0	84.0	450.	10.0	22.0
1381	400.	70.	100.	450.		
1401	42. DM	17.8 DM	21.8 DM	47.2 DM	2.17DM	3.35DM
1451	440.	82.	106.	480.	12.	16.
1471	465.	100.	121.	519.	3.5	14. EX
1481	340.	79.	98.	420.	8.	16.
1501	420.	80.	100.	460.	20.	20.
1521	440.	90.	115.	490.	10.	15.
1571	420.	90.	110.	470.	10.	20.
1681	470.	< 10.	< 10.	450.	80.	110.
1691	480.	100.	130.	490.	< 1.	10.
1901	441.	88.	103.	483.	13.	18.
1951	420.	90.	120.	455.	12. CT	16. CT
2041	501.	119.	132.	564.	10. EX	15. EX
2121	337.	67.	67.	374.	10.	13.
2491	400.	80.	80.	470.	11. CT	17. CT
2501	390.	76.	90.	435.		
2521	400.	80.	120.	280.	< 30.	< 30.
2591	430.	87. CT	100. CT	470.	12. CT	19. CT
2621	450.	100.	120.	480.	10.	20.
2671	530.	100.	110.	520.	13.	20.
2721	9.75	2.0	3.5	11.5	1.5	0.8
2731	457.	89.	118.	496.	19.	27.
2791	400.	80.	117.	400.	80. EX	70. EX
2821	458.	93.	116.	516.		

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

TABLE 18: ALL DATA RECEIVED FOR MANGANESE IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
2911	380.	95.	82.	369.	12.	14.
3221	420.	90.	120.	460.	10.	10.
3241	400.	55.	80.	530.		
3291	413.	73.	93.	460.	32. EX	32. EX
3381	380.	80.	90.	430.	< 50.	< 50.
3521	410.	85.	100.	450.	13.	18.
3561	510.	270.	300.	600.	150.	180.
3741	880.	150.	200.	960.	20.	10.
3791	400. DM	78. DM	95. DM	450. DM	9.5 DM	16. DM
3931	630.	200.	170.	720.	220.	40.
3971	650.	130.	150.	650.	0.	10.
4021	420.	80.	120.	460.	20.	10.
4411	430. CT	85. CT	110. CT	475. CT	10. CT	16. CT
4421	363.	67.	78.	390.	9. CT	14. CT
4431	440.	170.	90.	447.	47.	12.
4441	501.	68.	100.	496.	< 10.	25.
4451	410.	80.	90.	410.	80.	90.
4461	390.	80.	120.	420.		20.
4471	430.	92.	122.	507.	24.	25.
4491	370.	70.	90.	410.		
4501	435.	185.	210.	446.	22.6	33.
4511	365. EX	85. EX		435. EX	12. EX	18. EX
4521	440.	90.	100.	470.		
4531	400.	80.	100.	450.	20.	30.
4561	420.	80.	100.	480.	< 10.	10.
4571	400.	71.	32.	399.	76.	31.
4581	541.	126.	161.	642.	63.	36.
4621	415. CT	87. CT	103. CT	461. CT	11. CT	18. CT
4631	432.	83.	103.	46.	9.	17.
4641	402.	75.	97.	439.	4.	22.
4651	420.	60.	80.	470.	2.	2.
4661	160. EX	90. EX	80. EX	120. EX	90. EX	90. EX
4671	370.0	70.0	90.0	420.0	0.	0.
4681	450.	100.	120.	490.	20.	20.
4701	453.	96.	118.	492.	10. DM	17. DM
4711	450.	70.	100.	500.	0.	0.
4721	422.	81.	102.	464.	14.	15.
4731	305.	60.	77.	330.		

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 18: ALL DATA RECEIVED FOR MANGANESE IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4741	430.	200.	230.	465.	20.	30.
4751	390.	75.	85.	405.	9. CT	15. EX
4771	458.	75.	106.	454.	30.	30.
4781	411.0	73.0	72.0	450.0		
4791	440. EX	100. EX	120. EX	490. EX	13. EX	18. EX
4801	461.	88. EX	122. EX	502.	11. EX	18. EX
4811	364.0	82.0	103.0	478.0	11.0	11.0
4821	390.	70.	85.	460.	< 40.	< 40.
4831	551.	128.	131.	436.	13.	13.
4851	434.	93.	114.	477.		
4861	452.			492.		
4871	424.	79.	106.	466.	0.	20.
4891	433.	85.	106.	470.	7.	18.
4901	300.	50.	75.	443.	64.	35.
4921	366.	71.	91.	454.	30.	28.
4931	400. EX	80. EX	100. EX	430. EX	12. EX	17. EX
4941	430.00	80.00	100.00	460.00	100.00	20.00
4961	40. EX	15. EX	19. EX	45. EX	2.1 EX	3.3 EX
4971	420.	75.	100.	452.	10. EX	10. EX
4981	435.	70.	88.	475.	3. EX	8. EX
4991	399.	121.	136.	440.		
5001	410.	60.	90.	450.	< 10.	< 10.
5011	3900.	1550.	1950.	4500.	125.	225.
5021	510. DM	100. DM	110. DM	550. DM	13. DM	17. DM
5031	425.	80.	105.	480.	11. CT	17. CT
5041	406.	42.	61.	456.	0.0	0.0
5061	450.	85.	110.	495.	12.	20.
5071	450.0	90.0	100.0	500.0	25.0 EX	18.0 EX
5181	420.	100.	100.	450.	0.	0.
5291	415.	82.	100.	450.	10.	18.
5391	460.	11. CT	18. CT	420.	88. CT	113. CT
5401	356.	78.	97.			
5501	430.	113.	136.	480.	25.	25.
5511	424.	83.	102.	471.	8.	13.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 19: ALL DATA RECEIVED FOR MANGANESE IN NATURAL WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	377.	85.	109.	464.	11.	12.
1021	410.	90.	90.	450.	6. CT	11. CT
1031	960.	387.	430.	1030.	210.	220.
1061	446. CT	85. CT	94. CT	486. CT		
1101	550.	80. CT	90. CT	320.	0. CT	10. CT
1111	354. CT	64. CT	81. CT	389. CT	7. CT	12. CT
1121	450.	100.	115.	495.	5. CT	12. CT
1131	423.	82.	104.	451.	9.	16.
1151	446.	80.	107.	500.	8.	24.
1171	430.	86.	107.	252.	8.0	20.
1221	422.	86.	105.	466.		
1241	331.	62.	78.	364.	8.0	16.
1371	410.	88.0	123.	430.	7.5	22.0
1381	420.	120.	140.	500.		
1451	400.	66.	110.	480.	20.	14.
1471	485.	105.	128.	528.	17. EX	16. EX
1501	430.			480.		
1521	450.	88.	118.	496.	11.	17.
1571	440.	90.	110.	490.	10.	20.
1901	438.	85.	111.	479.	13.	16.
2041	513.	110.	133.	560.	10. EX	15. EX
2121	354.	67.	84.	388.	3.4	10.
2491	420.	60.	80.	480.	11. CT	23. CT
2501	380.	81.	105.	408.	13.	26.
2521	400.	90.	110.	460.	0.	20.
2591	430.	87. CT	110. CT	470.	12. CT	19. CT
2621	450.	100.	110.	500.	10.	20.
2671	480.	80.	100.	520.	17.	16.
2731	478.	84.	116.	495.	20.	31.
2791	380.	90.	115.	350.	75. EX	80. EX
2821	440.	88.	108.	472.		
3221	430.	100.	130.	470.	10.	10.
3241	450.	120.	140.	530.		
3291	458.	99.	123.	504.	20. EX	36. EX
3381	380.	80.	90.	420.	< 50.	< 50.
3521	440.	100.	120.	460.	25.	30.
3561	450.	270.	300.	600.	120.	150.
3741	880.	160.	210.	980.	20.	10.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 19: ALL DATA RECEIVED FOR MANGANESE IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
3931	450.	70.	100.	500.	0.	0.
3971	600.	130.	150.	660.	10.	10.
4021	420.	90.	110.	460.	10.	10.
4411	428. CT	88. CT	105. CT	480. CT	9. CT	15. CT
4421	323.	54.	63.	340.	5. CT	8. CT
4431	850.	450.	470.	871.	461.	397.
4451	410.	80.	80.	410.	80.	80.
4461	390.	70.	100.	420.	50.	40.
4471	374.	63.	87.	408.	24.	20.
4491	380.	84.	110.	420.		
4501	456.	183.	178.	445.	26.	37.
4511	368. EX	86. EX		443. EX	12. EX	19. EX
4521				470.		
4561	450.	100.	100.	480.	20.	20.
4571	399.	73.	31.	396.	75.	33.
4581	705.	271.	305.	810.	123.	109.
4621	398. CT	82. CT	101. CT	455. CT	10. CT	17. CT
4631	464.	84.	105.	47.	10.	17.
4641	441.	117.	127.	484.	41.	46.
4651	420.	60.	80.	470.	10.	10.
4661	160. EX	80. EX	50. EX	120. EX	60. EX	60. EX
4671	368.	60.0	90.0	410.0	0.	0.
4681	460.	100.	120.	500.	20.	20.
4701	484.	103.	124.	518.	12. DM	18. DM
4711	450.	70.	100.	500.	0.	0.
4721	431.	76.	96.	474.	2.	17.
4731	325.	75.	85.	370.		
4771	458.	75.	106.	454.	30.	30.
4781	401.0	67.0	83.0	467.0	1.80	8.00
4791	420. EX	90. EX	110. EX	480. EX	11. EX	16. EX
4801	652.	282.	308.	689.	195.	209.
4811	358.0	87.0	108.0	456.0	10.0	10.0
4821	430.	90.	100.	460.	< 40.	< 40.
4851	422.	92.	117.	480.		
4861	452.			500.		
4871	449.	76.	102.	489.	7.	3.
4891	439.	87.	112.	479.	7.	16.
4901	345.	65.	55.	398.	55.	35.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 19: ALL DATA RECEIVED FOR MANGANESE IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4921	425.	35.	100.	485.	20.	0.
4931	440. EX	76. EX	97. EX	490. EX	10. EX	16. EX
4941	450.00	120.00	130.00	500.00	30.00	50.00
4961	44. EX	16. EX	21. EX	41. EX	2.0 EX	3.0 EX
4971	435.	95.	110.	485.	20. EX	20. EX
4981	479.	105.	109.	515.	3. EX	12. EX
4991	406.	127.	148.	448.		
5001	430.	90.	100.	480.	< 10.	< 10.
5011	4050.			4500.		
5031	433.	83.	113.	483.	10. CT	14. CT
5041	437.	82.	90.	471.	8.0	0.0
5061	450.	88.	110.	490.	12.	20.
5071	450.0	90.0	100.0	500.0	34.0 EX	34.0 EX
5181	400.	80.	80.	450.	30.	30.
5291	405.	80.	100.	450.	10.	18.
5391		< 5. CT	20. CT	380.	70. CT	90. CT
5401	348.	71.	97.			
5501	410.	90.	110.	456.	16.	20.
5511	420.	88.	104.	472.	7.	16.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 20: ALL DATA RECEIVED FOR SELENIUM IN DISTILLED WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	44.	8.9	17.	50.	2.9	6.8
1021	26.	11.	14.	26.	5.	8.
1031	1.9	1.3	1.8	1.7	1.3	< 1.0
1401	< 0.1 DM	< 0.1 DM	0.6 DM	0.9 DM	0.2 DM	0.2 DM
1421	39.	12.	20.	45.	3.0	5.5
1481	27.	5.0	5.7	22.	3.7	6.0
1691	16. DM	4.4 DM	17. DM	6.3 DM	1.3 DM	2.4 DM
1951	45. DM	10. DM	15. DM	48. DM	000. DM	5. DM
2041	45.	34.	33.	50.	14.	8.
2121	38.	9.7	14.	31.	4.9	7.8
2671	30. DM	30. DM	30. DM	60. DM	16. DM	19. DM
2911	35.	13.	19.	41.	5.	8.
3221	40.6	13.5	18.3	48.9	5.7	8.1
3291	27.	11.	11.	37.	5.	7.
3381	52.	21.	22.	53.	15.	12.
3521	240.	120.	130.	250.	36.	32.
4221	40. DM	11. DM	17. DM	47. DM	3.2 DM	6.6 DM
4441	16.2 EX	10.5 EX	7.8 EX	12.7 EX	0.55EX	0.75EX
4481	13.	8.	10.	25.	4.	1.
4702	21.	9.0	2.5	24.	3.0	7.0
4721	26.	8.2		23.	3.9	7.2
4921	290.	48.	115.	320.	7.	38.
4961	7.2 EX	1.6 EX	1.5 EX	7.3 EX	1.5 EX	1.9 EX
5021		140. DM		140. DM		
5041	29.	7.4	11.	34.	3.0	5.20
5291	31.	11.	19.	35.	4.6	10.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 21: ALL DATA RECEIVED FOR SELENIUM IN NATURAL WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	36.	10.	16.	46.	3.1	6.0
1021	21.	10.	13.	23.	3.	4.
1031	1.0	1.4	1.7	2.2	< 1.0	< 1.0
1421	37.	11.	19.	42.	3.8	7.2
1691		4.1 DM				2.2 DM
2041	27.	30.	43.	58.		
2121	35.	9.3	5.2	9.0	4.9	6.7
2671	40. DM	20. DM	30. DM	60. DM	16. DM	20. DM
3291	17.	6.	16.	31.	6.	3.
3381	48.	15.	21.	44.	9.	18.
3521	240.	120.	120.	250.	38.	33.
4221	41. DM	13. DM	19. DM	49. DM	5.4 DM	8.4 DM
4481	12.	3.	2.	17.	4.	3.
4702	91.	8.5	2.0	22.	2.5	6.5
4721		12.	13.	24.	4.6	5.9
4921	255.	60.	90.	285.	10.	38.
4961	8.0 EX	1.8 EX	2.0 EX	7.1 EX	1.7 EX	2.1 EX
5291	31.	12.	16.	30.	2.3	10.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 22: ALL DATA RECEIVED FOR ZINC IN DISTILLED WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	285.	70.	75.	320.	23.	18.
1021	330.	70. CT	90.	350.	26. CT	26. CT
1031	341.	66.	79.	359.	30.	38.
1061	274. CT	45. CT	50. CT	305. CT	9. CT	12. CT
1091	246.	22.	40.	252.		
1101	290.	61. CT	76. CT	310.	12. CT	14. CT
1111	281. CT	58. CT	71. CT	310. CT	12. CT	10. CT
1121	252.	50.	55.	260.	6. CT	9. CT
1131	273.	55.	68.	300.	4.	8.
1151	306.	83.	88.	344.	21. EX	13. EX
1161	340.	223.	96.	360.	< 10.	< 10.
1171		72.	101.		32.	38.
1221	276.	63.	69.	305.		
1241	282.	59.	75.	310.	9.0	10.
1301	270.	60.	70.	310.	< 20.	< 20.
1371	330. EX	74.0 EX	100. EX	360. EX	19.5 EX	14.5 EX
1381	260.	50.	60.	300.	0.8 EX	1.2 EX
1401	28. DM	11.4 DM	14.0 DM	29.8 DM	1.6 DM	2.2 DM
1451	270.	48.	75.	310.	4.	20.
1471	249.	54.	63.	257.	13.	14.
1481	260.	53.	76.	305.	9.0	11.
1501	260.	140.	40.	260.	40.	20.
1521	273.	58.	72.	293.	11.	13.
1571	300.	60.	80.	310.	10.	10.
1681	290.	< 10.	< 10.	280.	50.	70.
1691	268.	60.	60.	330.	10.	20.
1701	242.	51.	64.	269.	4.6	9.7
1901	280.	52.	65.	310.	4. EX	8. EX
1951	270.	65.	100.	300.	5. CT	7. CT
2041	318.	68.	91.	353.	6. EX	11. EX
2121	286.	57.	67.	312.	6.7	10.
2301	293.	68.	68.	319.	6.	20.
2491	310.	50.	60.	310.	16. CT	19. CT
2501	280.	50.	63.	300.		
2521	272.	40.	59.	460.	10.	10.
2591	265. EX		60. EX	287. EX	7.5 EX	10. EX
2621	290.	60.	70.	310.	< 10.	10.
2671	280.	53.	71.	300.	7.	5.
2721	3.9	0.6	1.1	3.7	1.1	1.4
2731	2746.	508.	746.	3064.		
2791	495.	50.	85.	370.	75.	40.
2821	308.	58.	80.	348.	0.50EX	3.0 SB

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 22: ALL DATA RECEIVED FOR ZINC IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
2831	285. EX	48. EX	73. EX	335. EX	< 25. EX	< 25. EX
2911	373.	121.	94.	323.	84.	63.
3091	290.	110.	130.	410.	30.	30.
3221	320.	60.	80.	340.	30.	30.
3241	280.	30.	43.	320.		
3291	324.	156.	184.	400.	75.	134.
3381	330.	100.	110.	380.	60.	70.
3521	270.	50.	61.	300.	10.	11.
3561	360.	120.	80.	320.	10.	20.
3741	250.		20.	290.		
3791	270. DM	50. DM	63. DM	325. DM	8. DM	15. DM
3931	70. EX	32. EX	42. EX	76. EX	15. EX	15. EX
3971	330.	60.	80.	380.	0.	0.
4021	310.	100.	100.	310.	50.	10.
4221	384. EX	46. EX	54. EX	376. EX	8. EX	14. EX
4401	299.	56.	73.	337.	< 50.	< 50.
4411	300. CT	58. CT	70. CT	350. CT	8.1 CT	12. CT
4421	252.	45.	60.	262.	25. CT	37. CT
4441	260.	75.	65.	320.	< 5.	10.
4451	340.	90.	110.	340.	90.	110.
4461	260.	60.	60.	270.	1.7 EX	1.6 EX
4471	273.	48.	60.	286.	5.	10.
4481	230.	100.	80.	200.	60. EX	80. EX
4491	230.	52.	54.	255.		
4501	285.	141.	150.	308.	5.	15.
4511	358.	102.		330.	8.	4.
4521	270.	30.	50.	300.		
4531	250.	80.	100.	300.	10.	20.
4541	1470.	274.	385.	1570.	49.	62.
4551	275.	<150.	<150.	310.	<150.	<150.
4561	300.	80.	80.	180.	20.	20.
4571	380.	114.	76.	378.	115.	79.
4581	134.	23.	27.	146.	33.	34.
4591	130.	10.	30.	170.	0.	0.
4601	210.	60.	1030.	210.	< 20.	20.
4621	381. CT	83. CT	81. CT	381. CT	17. CT	28. CT
4631	281.	57.	65.	315.	9.0	
4641	71.	12.	14.	77.	0.	2.
4651	720.	100.	160.	800.	20.	40.
4671	260.0	50.0	70.0	285.0	0.	0.
4681	280.	60.	70.	300.	10.	20.
4691	500.	100.	100.			

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 22: ALL DATA RECEIVED FOR ZINC IN DISTILLED WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4701	287.	52.	72.	315.	9.1 EX	12. EX
4711	310.	90.	60.	340.	0.	0.
4721	254.	43.	55.	286.	4.	4.
4741	320.	95.	132.	340.	18.	25.
4751	290.	60.	70.	300.	6. CT	10. EX
4761	290.	60.	70.	320.	20.	20.
4771	264.	59.	99.	290.	18.	9.0
4781	589.0	110.0	126.0	425.0	98.0	97.0
4791	300. EX	90. EX	100. EX	300. EX	60. EX	100. EX
4801	260.	52. EX	65. EX	280.	7.0 EX	10. EX
4811	230.0	60.0	75.0	301.0	16.0	16.0
4821	223.	65.	78.	242.	< 20.	< 20.
4831	301.	61.	90.	268.	13.	15.
4841	290.	60.	80.	330.	10.	10.
4861	280.	52.	66.	307.		
4871	370.	200.	223.	323.	56.	62.
4881	300.	50. EX	47. EX	270.	20. EX	25. EX
4891	284.	57.	70.	309.	4.	14.
4901	475.	85.	100.	485.	17.	35.
4911	284.	54.	67.	307.	6.8	12.
4921	280.	59.	62.	370.	16.	23.
4931	280.	60. EX	75. EX	330.	7.0 EX	11. EX
4941	280.00	60.00	70.00	330.00	10.00	10.00
4961	32. EX	11. EX	15. EX	38. EX	1.6 EX	2.4 EX
4971	230.	46.	55.	270.	< 5. EX	15. EX
4981	318.	72.	85.	320.	24. EX	33. EX
4991	298.	64.	76.	303.	11.	18.
5001	270.	40.	60.	310.	< 20.	< 20.
5021	310. DM	97. DM	120. DM	360. DM	15. DM	
5031	265.	70.	80.	300.	30. CT	31. CT
5041	305.	8.0	12.	306.	0.0	0.0
5061	280.	55.	70.	300.	7.0	11.
5071	300.	65.	80.	320.	10.	20.
5181	280.	50.	70.	300.	0.0	0.0
5291	242.	35.	43.	265.	7.0	7.5
5361	288.	61.	72.	321.	11.	16.
5371	.297	.057	.007	.328	.012	.014
5391	300.	12. CT	33. CT	280.	73. CT	95. CT
5401	283.	60.	63.			
5501	290.	50.	70.	306.	8. EX	11. EX
5511	283.	56.	68.	315.	8. EX	11. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 23: ALL DATA RECEIVED FOR ZINC IN NATURAL WATER, UG/L

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
1011	268.	73.	73.	308.	22.	16.
1021	350.	60.	60.	310.	10.	20.
1031	336.	77.	83.	370.	50.	58.
1061	283. CT	61. CT	71. CT	323. CT	4.	4.
1091	246.	24.	41.	251.		
1101	290.	60. CT	75. CT	330.	8. CT	6. CT
1111	293. CT	52. CT	65. CT	309. CT	4. CT	8. CT
1121	280.	47.	52.	270.		8. CT
1131	272.	54.	68.	300.	3.	8.
1151	278.	74.	91.	353.	27. EX	26.
1161	440.	106.	86.	340.	< 10.	< 10.
1171	308.	95.	116.	358.	37.	45.
1221	280.	52.	62.	318.		
1241	224.	38.	46.	243.	0.0	0.0
1371	310. EX	74.0 EX	82.0 EX	290. EX	19.5 EX	17.0 EX
1381	250.	40.	60.	300.	2.2 EX	3.4 EX
1451	270.	50.	88.	310.	10.	17.
1471	262.	58.	55.	262.	14.	12.
1501	230.			250.		
1521	267.	56.	68.	300.	9.	11.
1571	280.	60.	70.	310.	10.	20.
1701	557.	150.	135.	189.	0.0	0.0
1901	279.	66.	67.	304.	5. EX	5. EX
2041	323.	68.	100.	363.	8. EX	10. EX
2121	285.	57.	70.	312.	5.6	12.
2301	273.	56.	73.	306.	6.	15.
2491	300.	70.	80.	330.	16. CT	20. CT
2501	390.	42.	59.	390.		
2521	275.	40.	67.	460.	10.	10.
2591	265. EX	50. EX	62. EX	290. EX		9.5 EX
2621	290.	50.	70.	320.	< 10.	20.
2671	280.	53.	72.	310.	3.	3.
2731	2736.	616.	786.	3124.		
2791	490.			400.		
2821	313.	65.	73.	343.	0.67SB	1.5 SB
2831	270. EX	55. EX	56. EX	315. EX	< 25. EX	< 25. EX
3091	310.	80.	160.	370.	30.	30.
3221	320.	60.	80.	340.	30.	30.

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

TABLE 23: ALL DATA RECEIVED FOR ZINC IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1		SAMPLE 2		SAMPLE 3		SAMPLE 4		SAMPLE 5		SAMPLE 6	
3241	310.		85.		92.		350.					
3291	381.		118.		158.		453.		80.		95.	
3381	310.		80.		100.		340.		50.		70.	
3521	280.		50.		60.		300.		10.		12.	
3561	280.		80.		120.		320.		30.		20.	
3741	260.		10.		30.		290.					
3931	74.	EX	38.	EX	37.	EX	77.	EX	19.	EX	17.	EX
3971	340.		70.		90.		370.		10.		20.	
4021	330.		90.		90.		320.		70.		10.	
4221	380.	EX	56.	EX	58.	EX	396.	EX	58.	EX	18.	EX
4401	304.		59.		69.		330.		< 50.		< 50.	
4411	310.	CT	60.	CT	74.	CT	340.	CT	8.0	CT	13.	CT
4421	238.		37.		42.		253.		0.	CT	23.	CT
4451	330.		90.		100.		330.		90.		100.	
4461	260.		60.		60.		280.					
4471	246.		45.		58.		256.		10.		9.	
4481	210.		100.		80.		200.		70.	EX	90.	EX
4491	210.		50.		80.		230.					
4501	285.		149.		151.		299.		4.		14.	
4511	358.		82.				354.		6.		12.	
4521							310.					
4541	1423.		375.		282.		1527.		55.		71.	
4551	300.		<150.		<150.		325.		<150.		<150.	
4561	300.		70.		90.		190.		30.		30.	
4571	385.		115.		80.		382.		117.		83.	
4581	1135.		870.		770.		504.		448.		393.	
4591	150.		30.		50.		190.		0.		0.	
4601	1250.		1030.		70.		1250.		970.		990.	
4621	301.	CT	44.	CT	64.	CT	316.	CT	9.	CT	14.	CT
4631	282.		60.		67.		315.		10.			
4641	72.		13.		16.		79.		2.		4.	
4651	720.		100.		160.		780.		20.		40.	
4671	65.0		0.		85.0		0.		0.		0.	
4681	290.		70.		80.		300.		10.		20.	
4691	550.		100.		100.							
4701	284.		55.		71.		313.		7.8	EX	12.	EX
4711	2200.		1400.		-1000.		-800.		-1700.		-1100.	
4721	253.		42.		54.		284.		1.		1.	

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

USEPA METHOD STUDY 7, TRACE METALS

TABLE 23: ALL DATA RECEIVED FOR ZINC IN NATURAL WATER, UG/L (continued)

LAB/ ANALYST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
4761	290.	70.	80.	330.	30.	30.
4771	264.	55.	85.	290.	16.	8.0
4781	263.0	74.0	120.0	388.0	60.0	
4791	300. EX	90. EX	100. EX	300. EX	60. EX	100. EX
4801	262.	60. EX	73. EX	293.	15. EX	17. EX
4811	235.0	55.0	66.0	295.0	13.0	9.0
4821	290.	63.	80.	330.	< 20.	< 20.
4861	280.	55.	67.	307.		
4881	220.			170.		
4891	289.	54.	72.	313.	6.	14.
4901	428.	70.	87.	453.	8.	4.
4911	277.	63.	75.	314.	12.	13.
4921	303.	52.	66.	314.	12.	18.
4931	290.	58. EX	75. EX	340.	9.0 EX	14. EX
4941	290.00	60.00	70.00	330.00	10.00	10.00
4961	33. EX	13. EX	17.0 EX	36. EX	1.8 EX	2.6 EX
4971	250.	47.	59.	285.	6. EX	7. EX
4981	283.	53.	69.	292.	11. EX	16.
4991	282.	74.	78.	301.	11.	21.
5001	280.	50.	70.	290.	< 20.	< 20.
5031	275.	65.	85.	300.	8. CT	14. CT
5041	243.	0.0	21.	282.	0.0	0.0
5061	280.	55.	70.	300.	7.0	11.
5071	300.	65.	80.	320.	10.	20.
5181	260.	30.	60.	300.	0.0	0.0
5291	258.	35.	43.	265.	6.9	8.0
5371	.267	.044	.059	.300	.003	.007
5391		< 5. CT	10. CT	300. CT	60. CT	70. CT
5401	304.	88.	103.			
5501	265.	55.	65.	301.	7. EX	8. EX
5511	411.	78.	86.	322.	11. EX	9. EX

* = REJECTED VALUE, CT = CONCENTRATION, EX = EXTRACTION
DM = DIFFERENT METHOD, SB = SAMPLING BOAT/RIBBON

APPENDIX C

TABLE OF EVALUATED DATA

USEPA METHOD STUDY 7, TRACE METALS

TABLE 24: EVALUATED DATA FOR ALUMINUM IN DISTILLED WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		1205.00	500.00	625.00	1004.00
LAB/AN	LAB REJECTED				
1011		1500.00	430.00	640.00	1030.00
1021		1400.00	*	*	1000.00
1031		1660.00	1300.00*	940.00	940.00
1091		1300.00	700.00	700.00	1000.00
1121		800.00	280.00	340.00	560.00
1131		1140.00	500.00	520.00	970.00
1151		1224.00	520.00	674.00	1040.00
1221		1330.00	500.00	650.00	1020.00
1371		500.00	640.00	500.00	820.00
1481		1100.00	500.00	750.00	1000.00
1521		1300.00	500.00	700.00	1000.00
1571		1200.00	420.00	500.00	870.00
1691		620.00	310.00	400.00	520.00
2041		960.00	340.00	500.00	82.00*
2121		1167.00	333.00	500.00	833.00
2521		1400.00	600.00	700.00	1000.00
2621		1020.00	530.00	540.00	1010.00
2821		1205.00	450.00	542.00	1039.00
2911		1160.00	500.00	620.00	1000.00
3091		1300.00	1000.00	800.00	1000.00
3221		1000.00	500.00	500.00	1000.00
3291		1225.00	525.00	504.00	1025.00
3381		900.00	600.00	600.00	900.00
3521		1300.00	470.00	580.00	1000.00
3741		1400.00	600.00	800.00	1200.00
3931		1500.00	400.00	1000.00	1400.00
3971		1200.00	700.00	700.00	1200.00
4401		1180.00	570.00	510.00	1014.00
4441		870.00	220.00	270.00	670.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 24: EVALUATED DATA FOR ALUMINUM IN DISTILLED WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		1205.00	500.00	625.00	1004.00
LAB/AN	LAB REJECTED				
4521		1200.00	500.00	600.00	1000.00
4531		1400.00	500.00	600.00	1000.00
4561		1240.00	500.00	660.00	1030.00
4581		1578.00	0.00*	0.00*	32.00*
4591		1300.00	1000.00	1000.00	800.00
4631		1231.00	424.00	596.00	1002.00
4651		1210.00	450.00	540.00	1150.00
4671		1000.00	500.00	500.00	1000.00
4681		1200.00	600.00	700.00	900.00
4701		1570.00	376.00	512.00	1139.00
4721	*	2101.00*	983.00*	972.00*	1903.00*
4751		1000.00	500.00	550.00	1000.00
4811		906.00	457.00	472.00	888.00
4961	*	103.00*	92.00*	116.00*	86.00*
4971		1300.00	450.00	700.00	950.00
4981		1281.00	0.76	0.63*	1487.00
5181		1300.00	600.00	600.00	1000.00
5401		1193.00	502.00	616.00	*
5511		1230.00	510.00	620.00	950.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 25: EVALUATED DATA FOR ALUMINUM IN NATURAL WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		1205.00	500.00	625.00	1004.00
LAB/AN	LAB REJECTED				
1011		1530.00	330.00	610.00	930.00
1021		1100.00	400.00	500.00	1100.00
1031	*	2140.00*	1500.00*	1660.00*	2000.00*
1091		1400.00	500.00	800.00	1000.00
1121		690.00	270.00	310.00	630.00
1131		1110.00	430.00	520.00	820.00
1151		976.00	241.00	331.00	802.00
1221		1250.00	380.00	580.00	920.00
1371		1000.00	350.00	350.00	350.00*
1481	*	*	*	*	*
1521		1200.00	500.00	700.00	1000.00
1571		1350.00	500.00	600.00	980.00
1691	*	*	*	*	*
2041		1020.00	420.00	460.00	74.00*
2121		1167.00	333.00	500.00	833.00
2521		1240.00	640.00	640.00	840.00
2621		1070.00	510.00	450.00	1060.00
2821		1150.00	467.00	590.00	1070.00
2911	*	*	*	*	*
3091		1400.00	800.00	800.00	1000.00
3221		1000.00	500.00	500.00	1000.00
3291		1225.00	513.00	625.00	1063.00
3381		600.00	600.00	600.00	900.00
3521		1300.00	510.00	590.00	1100.00
3741		1500.00	700.00	800.00	1300.00
3931		1600.00	500.00	1200.00	1500.00
3971		1200.00	700.00	700.00	1100.00
4401		1475.00	610.00	885.00	1210.00
4441	*	*	*	*	*

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 25: EVALUATED DATA FOR ALUMINUM IN NATURAL WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		1205.00	500.00	625.00	1004.00
LAB/AN	LAB REJECTED				
4521	*	*	*	*	1100.00*
4531	*	*	*	*	*
4561		1250.00	520.00	610.00	990.00
4581		1438.00	0.00*	64.00	26.00*
4591		1400.00	1000.00*	1300.00	900.00
4631		1301.00	428.00	600.00	1008.00
4651		1060.00	460.00	460.00	1060.00
4671		1250.00	600.00	600.00	1250.00
4681		1300.00	600.00	600.00	1000.00
4701		1640.00	400.00	575.00	1115.00
4721	*	2047.00*	919.00*	1168.00*	1883.00*
4751	*	*	*	*	*
4811		950.00	438.00	378.00	842.00
4961	*	99.00*	95.00*	110.00*	88.00*
4971		1450.00	550.00	600.00	1250.00
4981		1521.00	0.89*	0.79	1510.00
5181		1800.00	1100.00*	1200.00	1000.00
5401		1127.00	435.00	692.00	*
5511		1280.00	510.00	580.00	1090.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 26: EVALUATED DATA FOR ALUMINUM AT A LOW CONCENTRATION in ug/liter

EVALUATED DATA FOR ALUMINUM (CONCENTRATION TECHNIQUE)

	DISTILLED WATER		NATURAL WATER	
	AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L	35.00	15.00	35.00	15.00
LAB/AN LAB REJECTED				
102	110.00	90.00	*	*
106	11.00	11.00	35.00	10.00
110	50.00	30.00	20.00	150.00*
111	< 100.00*	< 100.00*	< 100.00*	< 100.00*
112	34.00	*	27.00	19.00
150	< 500.00*	< 500.00*	*	*
259	100.00	< 100.00*	100.00*	< 100.00*
443	88.00	35.00	283.00*	37.00
470	39.00	21.00	30.00	21.00

EVALUATED DATA FOR ALUMINUM (DIRECT ASPIRATION)

1011	200.00*	< 200.00*	200.00*	< 200.00*
1031	550.00*	550.00*	940.00*	550.00
1091	200.00	200.00	100.00	400.00
1131	30.00	60.00	30.00	0.00*
1151	0.00*	0.00*	0.00*	0.00*
1371	100.00*	220.00	100.00	< 100.00*
1481	100.00*	< 100.00*	*	*
1521	45.00	26.00	47.00	28.00
1571	0.00*	0.00*	50.00	20.00
1691	90.00	90.00	*	*
2121	167.00	0.00*	167.00	0.00*
2521	100.00	60.00	20.00	20.00
2621	200.00*	210.00	200.00*	< 200.00*
2911	100.00	100.00	*	*
3091	30.00*	< 30.00*	30.00*	< 30.00*
3221	*	*	0.00*	0.00*
3381	100.00*	< 100.00*	100.00*	< 100.00*
3521	67.00	39.00	65.00	46.00
3741	100.00	*	100.00	100.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 26: EVALUATED DATA FOR ALUMINUM AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR ALUMINUM (DIRECT ASPIRATION) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		35.00	15.00	35.00	15.00
LAB/AN	LAB REJECTED				
3931		300.00	400.00	400.00*	700.00
3971		200.00	300.00	300.00*	200.00
4401		500.00*	< 500.00*	500.00*	< 500.00*
4441		50.00*	< 50.00*	*	*
4531		100.00*	< 100.00*	*	*
4561		30.00	70.00	30.00	10.00
4581		0.00*	0.00*	121.00	0.00*
4591		0.00*	0.00*	0.00*	0.00*
4631		100.00*	*	*	*
4651		150.00	150.00	160.00	160.00
4671		0.00*	0.00*	0.00*	0.00*
4681		0.00*	100.00	0.00*	100.00
4721		100.00*	121.00	194.00	465.00
4811		100.00*	< 100.00*	100.00*	< 100.00*
4921		< 1000.00*	< 1000.00*	< 1000.00*	< 1000.00*
4961		12.00	7.40	15.00	7.80
4971		400.00*	< 400.00*	400.00*	< 400.00*
5181		100.00	100.00	100.00	0.00*
5511		60.00	20.00	20.00	50.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 27: EVALUATED DATA FOR ARSENIC IN DISTILLED WATER (COLORIMETRY)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		292.00	80.00	67.00	266.00	29.00	20.00
LAB/AN	LAB REJECTED						
1011	*	405.00*	78.00*	70.00*	295.00*	32.00*	26.00*
1021		300.00	90.00	70.00	320.00	30.00	22.00
1031		215.00	100.00	50.00	150.00	8.00	12.00
1061		308.00	84.00	67.00	237.00	18.00	17.00
1092		257.00	83.00	66.00	229.00	29.00	23.00
1121		277.00	69.00	63.00	234.00	*	*
1131		311.00	9.00	0.00*	267.00	2.00	10.00
1241		285.00	70.00	65.00	480.00*	28.00	13.00
1371	*	11.40*	2.70*	3.00*	9.00*	1.70*	1.00*
1481		306.00	80.00	80.00	306.00	20.00	40.00
1521		250.00	74.00	60.00	210.00	24.00	12.00
1571		220.00	59.00	47.00	149.00	20.00	10.00
1691		280.00	100.00	70.00	260.00	30.00	20.00
1901		274.00	76.00	64.00	218.00	24.00	18.00
2041		325.00	55.00	23.00	252.00	25.00	< 13.00*
2501		317.00	37.00	43.00	157.00	23.00	8.60
2591		246.00	80.00	60.00	224.00	27.00	15.00
2791		40.00*	70.00	11.00	70.00	30.00	26.00
3091		250.00	80.00	40.00	250.00	30.00	20.00
3221		317.00	86.00	63.00	284.00	27.00	15.00
3291	*	199.00*	5.00*	6.00*	104.00*	8.00*	< 1.00*
3381		246.00	57.00	51.00	217.00	29.00	26.00
3521		270.00	55.00	49.00	230.00	< 30.00*	< 30.00*
3931		250.00	100.00	70.00	260.00	50.00	50.00*
4021		369.00	95.00	90.00	258.00	28.00	17.00

* = REJECTED

USEPA METHOD STUDY 7, TRACE METALS

TABLE 27: EVALUATED DATA FOR ARSENIC IN DISTILLED WATER (COLORIMETRY) (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		292.00	80.00	67.00	266.00	29.00	20.00
LAB/AN	LAB REJECTED						
4431		315.00	72.00	58.00	265.00	2.00	4.00
4441		156.00	44.00	45.00	199.00	6.00	< 4.00*
4461		290.00	70.00	50.00	290.00	*	*
4472		250.00	68.00	60.00	250.00	26.00	20.00
4481		240.00	56.00	46.00	221.00	6.60	4.90
4531		220.00	80.00	65.00	250.00	24.00	18.00
4551		314.00	71.00	62.00	276.00	22.00	22.00
4561		190.00	50.00	60.00	180.00	20.00	20.00
4581		206.00	46.00	37.00	183.00	37.00	17.00
4611		169.00	25.00	12.00	305.00	71.00*	43.00
4641	*	25.00*	1.00*	2.00*	26.00*	0.50*	1.00*
4681		210.00	100.00	70.00	250.00	40.00	30.00
4702		140.00	57.00	43.00	138.00	29.00	67.00*
4721		224.00	60.00	11.00	204.00	8.30	2.10
4861	*	336.00*	92.00*	75.00*	298.00*	30.00*	21.00*
4921	*	109.00*	17.00*	16.00*	129.00*	< 1.00*	< 1.00*
4941		234.00	60.00	63.00	237.00	26.00	6.00
4961		145.00	81.00	58.00	119.00	28.00	19.00
5031		232.00	85.00	55.00	262.00	26.00	20.00
5041		271.00	63.00	53.00	229.00	0.23	0.00*
5051		276.00	78.00	52.00	234.00	22.00	13.00
5061		298.00	81.00	64.00	278.00	29.00	21.00
5291	*	11.00*	3.00*	1.40*	11.00*	0.60*	0.20*
5401		240.00	74.00	53.00	*	*	*
5511		264.00	50.00	42.00	208.00	4.00	*

* = REJECTED

USEPA METHOD STUDY 7, TRACE METALS

TABLE 28: EVALUATED DATA FOR ARSENIC IN NATURAL WATER (COLORIMETRY)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		292.00	80.00	67.00	266.00	29.00	20.00
LAB/AN	LAB REJECTED						
1011	*	328.00*	111.00*	85.00*	270.00*	32.00*	26.00*
1021		288.00	96.00	60.00	298.00	22.00	14.00
1031		150.00	100.00	80.00	140.00	29.00	12.00
1061		286.00	83.00	83.00	251.00	33.00	26.00
1092		257.00	84.00	71.00	197.00	23.00	20.00
1121		229.00	74.00	60.00	231.00	*	*
1131		210.00	32.00	0.00*	195.00	2.00	0.00*
1241		270.00	94.00	60.00	320.00	25.00	16.00
1371	*	14.50*	3.30*	3.00*	12.50*	1.00*	*
1481	*	*	*	*	*	*	*
1521		260.00	73.00	59.00	202.00	23.00	14.00
1571		*	54.00	42.00	*	18.00	6.00
1691	*	*	*	*	*	*	*
1901		286.00	62.00	59.00	215.00	30.00	16.00
2041		305.00	83.00	45.00	252.00	20.00	13.00
2501		398.00	71.00	48.00	257.00	28.00	14.40
2591		240.00	80.00	*	214.00	26.00	14.00
2791		57.00*	40.00	9.00	67.00	28.00	20.00
3091		250.00	60.00	50.00	240.00	20.00	20.00
3221		295.00	75.00	62.00	242.00	32.00	20.00
3291		202.00	15.00	< 1.00*	134.00	5.00	9.00
3381		242.00	60.00	51.00	208.00	22.00	17.00
3521		280.00	72.00	59.00	270.00	< 30.00*	< 30.00*
3931		250.00	100.00	70.00	260.00	50.00	50.00*
4021	*	*	*	*	*	*	*

* = REJECTED

USEPA METHOD STUDY 7, TRACE METALS

TABLE 28: EVALUATED DATA FOR ARSENIC IN NATURAL WATER (COLORIMETRY) (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		292.00	80.00	67.00	266.00	29.00	20.00
LAB/AN	LAB REJECTED						
4431		224.00	27.00	17.00	158.00	4.00	2.00
4441	*	*	*	*	*	*	*
4461		290.00	90.00	50.00	290.00	*	*
4472		289.00	80.00	62.00	243.00	27.00	20.00
4481		234.00	49.00	39.00	203.00	10.00	3.10
4531	*	*	*	*	*	*	*
4551		278.00	68.00	61.00	264.00	26.00	20.00
4561		190.00	40.00	60.00	190.00	30.00	10.00
4581		211.00	57.00	37.00	206.00	23.00	14.00
4611		183.00	79.00	56.00	389.00	117.00*	99.00*
4641	*	25.00*	3.00*	2.00*	24.00*	1.00*	2.00*
4681		240.00	80.00	30.00	250.00	30.00	20.00
4702		129.00	63.00	29.00	143.00	34.00	60.00*
4721		258.00	57.00	11.00	224.00	8.00	< 1.00*
4861	*	343.00*	87.00*	72.00*	303.00*	31.00*	22.00*
4921	*	109.00*	20.00*	9.00*	114.00*	< 1.00*	< 1.00*
4941		234.00	77.00	63.00	237.00	34.00	17.00
4961		140.00	84.00	53.00	123.00	25.00	22.00
5031		262.00	85.00	55.00	262.00	30.00	21.00
5041		281.00	60.00	57.00	246.00	0.91	0.23
5051	*	328.00*	146.00*	135.00*	316.00*	97.00*	87.00*
5061		290.00	78.00	66.00	270.00	30.00	20.00
5291	*	12.00*	3.20*	2.60*	11.00*	0.60*	0.20*
5401		236.00	78.00	58.00	*	*	*
5511		259.00	68.00	44.00	251.00	12.00	*

* = REJECTED

USEPA METHOD STUDY 7, TRACE METALS

TABLE 29: EVALUATED DATA FOR CADMIUM IN DISTILLED WATER

LAB/AN	LAB REJECTED	AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		71.00	14.00	18.00	78.00
1011		65.00	17.00	18.00	73.00
1031		90.00	16.00	14.00	77.00
1121		75.00	15.00	20.00	77.00
1131		69.00	13.00	14.00	77.00
1171		*	12.00	18.00	*
1221		73.00	12.00	22.00	77.00
1241		71.00	14.00	19.00	76.00
1471		74.00	24.00	26.00	82.00
1571		70.00	20.00	20.00	80.00
1901		68.00	11.00	11.00	74.00
2041		81.00	19.00	22.00	86.00
2121		67.00	13.00	17.00	77.00
2301		77.00	13.00	17.00	72.00
2491		40.00	30.00	40.00	80.00
2521		61.00	8.00	100.00*	66.00
2671	*	44.00*	7.00*	9.00*	57.00*
3221		110.00	11.00	14.00	110.00
3241		81.00	12.00	25.00	87.00
3381		72.00	20.00	20.00	72.00
3521		71.00	16.00	18.00	78.00
3561	*	100.00*	70.00*	60.00*	210.00*
3741		60.00	10.00	10.00	70.00
4421		58.00	10.00	10.00	63.00
4451		60.00	10.00	10.00	70.00
4461		70.00	20.00	20.00	40.00
4471		59.00	10.00	11.00	71.00
4501		50.00	35.00	33.00	51.00
4571		70.00	16.00	20.00	70.00
4581		95.00	0.00*	40.00	38.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 29: EVALUATED DATA FOR CADMIUM IN DISTILLED WATER (continued)

LAB/AN	LAB REJECTED	AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		71.00	14.00	18.00	78.00
4641		7.00*	11.00	16.00	85.00
4651		60.00	10.00	7.00	60.00
4671		80.00	0.00*	1.00	70.00
4691	*	100.00*	50.00*	50.00*	100.00*
4721		70.00	16.00	13.00	79.00
4731		68.00	15.00	17.00	73.00
4761	*	140.00*	40.00*	100.00*	140.00*
4771		68.00	13.00	15.00	62.00
4811		59.00	29.00	20.00	78.00
4891		68.00	16.00	19.00	74.00
4901		33.00	13.00	16.00	28.00*
4921		67.00	18.00	19.00	75.00
4941		69.00	20.00	19.00	74.00
4971		68.00	13.00	15.00	71.00
4981		82.00	25.00	25.00	84.00
4991		83.00	29.00	27.00	76.00
5041		70.00	21.00	11.00	68.00
5181		70.00	15.00	200.00*	80.00
5291		72.00	14.00	18.00	76.00
5501		90.00	40.00*	40.00	93.00
5511		65.00	15.00	17.00	71.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 30: EVALUATED DATA FOR CADMIUM IN NATURAL WATER

LAB/AN	LAB REJECTED	AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		71.00	14.00	18.00	78.00
1011		67.00	18.00	25.00	77.00
1031		74.00	9.50	7.30	80.00
1121		71.00	15.00	22.00	73.00
1131		69.00	13.00	13.00	77.00
1171		78.00	13.00	18.00	85.00
1221		70.00	18.00	23.00	82.00
1241		59.00	14.00	14.00	63.00
1471		73.00	23.00	25.00	81.00
1571		70.00	20.00	20.00	80.00
1901		71.00	14.00	20.00	78.00
2041		81.00	18.00	20.00	86.00
2121		70.00	17.00	20.00	80.00
2301		61.00	12.00	13.00	76.00
2491		50.00	30.00	30.00	90.00
2521		60.00	7.00	139.00*	65.00
2671		69.00	17.00	16.00	60.00
3221		110.00*	11.00	14.00	110.00
3241		67.00	11.00	19.00	85.00
3381		64.00	20.00	23.00	72.00
3521		71.00	16.00	18.00	76.00
3561	*	140.00*	170.00*	150.00*	250.00*
3741		70.00	10.00	10.00	70.00
4421		57.00	8.00	10.00	57.00
4451		60.00	10.00	10.00	70.00
4461		70.00	20.00	20.00	*
4471		63.00	12.00	14.00	70.00
4501		51.00	32.00	33.00	52.00
4571		70.00	15.00	20.00	71.00
4581		97.00*	13.00	30.00	49.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 30: EVALUATED DATA FOR CADMIUM IN NATURAL WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		71.00	14.00	18.00	78.00
LAB/AN	LAB REJECTED				
4641		8.00*	24.00	26.00	94.00
4651	*	50.00*	5.00*	6.00*	50.00*
4671		80.00	0.00*	0.00*	70.00
4691	*	100.00*	50.00*	60.00*	100.00*
4721		69.00	16.00	11.00	78.00
4731		78.00	20.00	22.00	96.00
4761	*	140.00*	50.00*	110.00*	140.00*
4771		60.00	13.00	15.00	61.00
4811		69.00	28.00	26.00	83.00
4891		68.00	*	21.00	76.00
4901		28.00*	12.00	14.00	32.00*
4921		66.00	16.00	16.00	70.00
4941		64.00	9.00	15.00	70.00
4971		71.00	15.00	17.00	74.00
4981		84.00	21.00	25.00	85.00
4991		76.00	28.00	26.00	83.00
5041		69.00	15.00	13.00	70.00
5181		70.00	15.00	200.00*	80.00
5291		71.00	12.00	18.00	76.00
5501		90.00	30.00	33.00	91.00
5511		64.00	14.00	15.00	72.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 31: EVALUATED DATA FOR CADMIUM AT A LOW CONCENTRATION in ug/liter

EVALUATED DATA FOR CADMIUM (CONCENTRATION TECHNIQUE)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		1.40	2.80	1.40	2.80
LAB/AN	LAB REJECTED				
102		1.00	2.00	*	2.00
106		1.80	2.80	1.00	2.70
111		< 2.50*	3.00	< 2.50*	3.00
112		2.00	2.00	2.00	2.00
249		4.00*	3.00	5.00	4.00
441		1.10	3.00	1.30	2.90
442		1.00	2.00	0.00*	1.00
443		1.70	2.70	3.40	6.60
503		1.00	4.00	3.00	4.00
539		14.00*	17.00*	13.00*	15.00*

EVALUATED DATA FOR CADMIUM (EXTRACTION TECHNIQUE)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
101		4.20	1.70	3.80	1.70
103		7.00*	8.00*	1.00	< 1.00*
137		3.00	2.00	3.00	2.00
138		0.10	0.10	0.10	0.10
145		1.00	3.00	1.00	3.00
147		2.00	2.80	1.40	3.40
150		*	*	*	*
152		2.00	7.00*	4.00	5.00
169		2.20	3.80	*	*
195		2.00	3.50	*	*
204		2.00	3.00	1.00	3.00
259		1.20	2.80	1.20	2.80
262		< 1.00*	2.80	1.90	2.80
267		1.30	3.80	1.60	4.10
272		2.00	1.80	*	*
279		3.00	4.10	3.00	4.00
282		0.95	2.20	1.40	2.90
322		1.50	2.80	1.50	2.80
329		14.00*	< 1.00*	15.00*	*
338		2.50	3.20	2.00	3.60
393		4.00	4.00	2.00	3.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 31: EVALUATED DATA FOR CADMIUM AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR CADMIUM (EXTRACTION TECHNIQUE) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		1.40	2.80	1.40	2.80
LAB/AN	LAB REJECTED				
422		4.00	6.00	6.00*	6.00
446		1.50	2.70	1.40	3.20
451		0.40	2.00	0.40	2.40
453		2.40	3.20	*	*
463		68.00*	2.50	*	*
468		3.00	4.00	4.00	3.00
470		1.20	2.40	1.40	2.30
471		1200.00*	0.00*	1200.00*	0.00*
475		1.00	2.00	1.00	2.00
478		19.00*	23.60*	10.00*	12.00*
479		1.50	2.50	1.50	2.50
480		2.10	3.00	3.40	4.30
488		19.00*	53.00*	21.00*	46.00*
492		2.00	2.00	1.00	2.00
493		1.50	2.50	1.50	2.50
496		0.60	0.80	0.40	1.00
497		4.00	4.00	4.00	4.00
498		0.40	0.96	0.40	2.00
499		0.26	0.30	0.28	0.31
506		1.00	2.40	1.00	2.40
507		< 1.00*	< 1.00*	< 1.00*	< 1.00*
539		14.00*	17.00*	13.00*	15.00*
550		3.00	5.00	3.00	4.00
551		0.60	2.10	1.00	2.20

EVALUATED DATA FOR CADMIUM (DIRECT ASPIRATION)

1131	2.00	3.00	1.00	2.00
1161	7.00*	< 7.00*	7.00*	< 7.00*
1171	1.40	1.80	1.40	1.60
1241	2.00	7.00	3.00	3.00
1301	250.00*	< 250.00*	*	*
1481	10.00*	18.00*	*	*
1571	10.00	0.00*	10.00*	0.00*
1681	10.00*	< 10.00*	*	*

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 31: EVALUATED DATA FOR CADMIUM AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR CADMIUM (DIRECT ASPIRATION) (continued)

		DISTILLED WATER			NATURAL WATER		
		AMPUL 5		AMPUL 6	AMPUL 5		AMPUL 6
INCREMENT IN UG/L		1.40		2.80	1.40		2.80
LAB/AN	LAB REJECTED						
1901		1.00		0.00*	0.00*		1.00
2121		0.00*		0.00*	0.00*		0.00*
2301		6.00*	<	6.00*	6.00*	<	6.00*
2521		2.40		3.70	0.70		2.50
3091		50.00*	<	50.00*	50.00*	<	50.00*
3521		4.00		5.00	4.00		5.00
3561		130.00*		90.00*	50.00*		160.00*
3971		0.00*		10.00	0.00*		10.00
4441		10.00*	<	10.00*	*		*
4451		10.00*	<	10.00*	10.00*	<	10.00*
4471		2.00*		1.00	2.00*	-	0.50*
4501		12.00		2.00	22.00*		12.00
4561		10.00*	<	10.00*	10.00*	<	10.00*
4571		15.00		20.00*	16.00*		22.00*
4581		49.00*		0.00*	41.00*		0.00*
4601		25.00*	<	25.00*	25.00*	<	25.00*
4641		0.00*		2.00	6.00		7.00
4671		4.00		4.00	0.00*		0.00*
4721		3.00		1.00	2.00		1.00
4761		0.00*		0.00*	0.00*		0.00*
4771		5.00		5.00	5.00		5.00
4811		1.00		2.00	1.00		2.00
4821		20.00*	<	20.00*	20.00*	<	20.00*
4831		3.00		3.00	*		*
4841		0.00*		0.00*	*		*
4871		0.00*		0.00*	0.00*		0.00*
4891		0.00*		1.00	3.00		3.00
4901		3.00		7.00	1.00		7.00
4941		0.00*		0.00*	0.00*		0.00*
5041		0.00*		2.00	0.00*		9.00
5181		0.00*		0.00*	0.00*		0.00*
5291		1.00		2.60	1.00		2.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 32: EVALUATED DATA FOR CHROMIUM IN DISTILLED WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		370.00	74.00	93.00	407.00
LAB/AN	LAB REJECTED				
1011		365.00	80.00	105.00	410.00
1021		350.00	80.00	100.00	380.00
1091	*	180.00*	20.00*	30.00*	190.00*
1121		310.00	70.00	90.00	410.00
1131		366.00	74.00	94.00	392.00
1161		350.00	80.00	90.00	380.00
1381		350.00	70.00	100.00	40.00*
1471		392.00	75.00	92.00	418.00
1521		380.00	83.00	104.00	420.00
1571		370.00	70.00	90.00	400.00
1701		394.00	76.00	102.00	480.00
1901		351.00	71.00	87.00	388.00
2041		384.00	76.00	106.00	426.00
2121		308.00	100.00	123.00	421.00
2301		423.00	90.00	115.00	432.00
2491		470.00	60.00	70.00	500.00
2521		390.00	85.00	100.00	410.00
2671	*	670.00*	100.00*	170.00*	680.00*
2731		110.00*	62.00	96.00	447.00
2821		373.00	72.00	90.00	420.00
3111		315.00	61.00	73.00	371.00
3221		400.00	90.00	95.00	450.00
3381		385.00	70.00	100.00	435.00
3521		340.00	55.00	72.00	360.00
3561	*	600.00*	300.00*	400.00*	750.00*
3741	*	650.00*	130.00*	200.00*	740.00*
3971		400.00	90.00	110.00	450.00
4401		413.00	90.00	100.00	481.00
4421		293.00	57.00	73.00	303.00
4431		350.00	100.00	96.00	324.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 32: EVALUATED DATA FOR CHROMIUM IN DISTILLED WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		370.00	74.00	93.00	407.00
LAB/AN	LAB REJECTED				
4451		410.00	80.00	110.00	410.00
4461		360.00	60.00	90.00	400.00
4471		265.00	42.00	50.00	296.00
4501		320.00	100.00	1.70*	351.00
4641		409.00	80.00	98.00	44.00*
4671		250.00	50.00	50.00	275.00
4711		510.00	117.00	117.00	500.00
4721		379.00	69.00	104.00	394.00
4781	*	190.00*	21.00*	30.00*	179.00*
4811		320.00	68.00	107.00	412.00
4821		220.00	100.00	100.00	260.00
4922		360.00	76.00	100.00	415.00
4981		283.00	83.00	112.00	428.00
5061		370.00	80.00	95.00	400.00
5071		400.00	90.00	100.00	480.00
5181		360.00	70.00	70.00	430.00
5291		342.00	73.00	85.00	390.00
5371	*	0.37*	0.09*	0.09*	0.42*
5501		440.00	140.00*	160.00*	473.00
5511		357.00	68.00	92.00	397.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 33: EVALUATED DATA FOR CHROMIUM IN NATURAL WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		370.00	74.00	93.00	407.00
LAB/AN	LAB REJECTED				
1011		380.00	62.00	103.00	420.00
1021		366.00	76.00	96.00	396.00
1091	*	180.00*	20.00*	30.00*	190.00*
1121		310.00	100.00	100.00	400.00
1131		334.00	64.00	90.00	359.00
1161		350.00	70.00	70.00	350.00
1381		270.00	40.00	70.00	30.00*
1471		392.00	75.00	92.00	415.00
1521		380.00	85.00	103.00	428.00
1571		370.00	70.00	90.00	410.00
1701		351.00	73.00	92.00	388.00
1901		350.00	68.00	87.00	385.00
2041		379.00	78.00	98.00	418.00
2121		308.00	82.00	100.00	421.00
2301		429.00	80.00	102.00	455.00
2491		470.00	50.00	60.00	510.00
2521		287.00	82.00	97.00	417.00
2671	*	690.00*	140.00*	180.00*	740.00*
2731		110.00*	58.00	96.00	447.00
2821		342.00	67.00	83.00	389.00
3111		320.00	53.00	71.00	380.00
3221		450.00	90.00	95.00	500.00
3381		385.00	60.00	100.00	435.00
3521		360.00	60.00	70.00	380.00
3561	*	600.00*	300.00*	400.00*	800.00*
3741	*	690.00*	150.00*	220.00*	790.00*
3971		400.00	90.00	110.00	400.00
4401		399.00	92.00	102.00	496.00
4421		300.00	53.00	63.00	333.00
4431		420.00	120.00	120.00	412.00

* = REJECTED VALUE

TABLE 33: EVALUATED DATA FOR CHROMIUM IN NATURAL WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		370.00	74.00	93.00	407.00
LAB/AN	LAB REJECTED				
4451		160.00*	30.00	80.00	340.00
4461		380.00	50.00	100.00	400.00
4471		236.00	62.00	57.00	236.00
4501		320.00	95.00	1.00*	353.00
4641		402.00	80.00	95.00	43.00*
4671		260.00	50.00	60.00	300.00
4711		493.00	130.00	147.00	512.00
4721		387.00	66.00	127.00	389.00
4781	*	98.00*	14.00*	2.00*	86.00*
4811		324.00	69.00	108.00	391.00
4821		380.00	180.00*	180.00*	380.00
4922		350.00	70.00	86.00	406.00
4981		283.00	76.00	67.00	289.00
5061		370.00	80.00	95.00	400.00
5071		400.00	90.00	100.00	480.00
5181		370.00	70.00	70.00	410.00
5291		343.00	76.00	85.00	390.00
5371	*	0.37*	0.09*	0.09*	0.42*
5501		413.00	120.00	170.00*	466.00
5511		353.00	70.00	84.00	380.00

* = REJECTED VALUE

TABLE 34: EVALUATED DATA FOR CHROMIUM AT A LOW CONCENTRATION in ug/liter

EVALUATED DATA FOR CHROMIUM (CONCENTRATION TECHNIQUE)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		7.40	15.00	7.40	15.00
LAB/AN	LAB REJECTED				
102		11.00	16.00	*	*
106		10.00	16.00	7.00	10.00
110		10.00	16.00	12.00	15.00
111		8.00	18.00	10.00	12.00
112		8.00	15.00	8.00	12.00
249		8.00	12.00	9.00	11.00
259		8.00	18.00	6.00	18.00
441		9.00	18.00	10.00	19.00
442		7.00	13.00	7.00	10.00
462		10.00	24.00*	7.00	15.00
475		6.00	14.00	*	*
503		9.00	14.00	6.00	13.00
539		65.00*	98.00*	70.00*	85.00*

EVALUATED DATA FOR CHROMIUM (EXTRACTION TECHNIQUE)

	DISTILLED WATER		NATURAL WATER	
	AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
103	< 1.00*	< 1.00*	< 1.00*	< 1.00*
145	8.00	13.00	10.00	13.00
147	6.00	11.00	6.40	14.00
190	7.00	15.00	7.00	16.00
204	8.00	16.00	8.00	15.00
262	6.00	17.00	6.00	16.00
267	2.00	10.00	5.00	12.00
279	7.00	13.00	23.00	24.00
283	20.00*	20.00	30.00*	20.00
311	5.00	15.00	3.00	13.00
322	10.00	20.00	10.00	20.00
329	23.00*	7.00	67.00*	13.00
338	< 5.00*	< 5.00*	< 5.00*	< 5.00*
374	17.00*	9.00	22.00	8.00
465	10.00	10.00	10.00	10.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 34: EVALUATED DATA FOR CHROMIUM AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR CHROMIUM (EXTRACTION TECHNIQUE) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		7.40	15.00	7.40	15.00
LAB/AN	LAB REJECTED				
470		6.50	14.00	10.00	20.00
479		6.00	12.00	6.00	12.00
480		10.00	17.00	15.00	22.00
488		5.00	10.00	6.00	10.00
490		7.00	17.00	3.00	15.00
492		6.00	14.00	12.00	22.00
493		8.00	16.00	8.00	16.00
496		2.10	3.80	2.50	3.60
497		< 40.00*	< 40.00*	< 40.00*	< 40.00*
498		< 0.10*	< 0.10*	< 0.10*	< 0.10*
506		8.00	15.00	8.00	15.00
507		< 4.00*	< 4.00*	< 4.00*	< 4.00*
550		9.00	12.00	11.00	10.00

EVALUATED DATA FOR CHROMIUM (DIRECT ASPIRATION)

1021	*	*	10.00	14.00
1131	8.00	16.00	4.00	8.00
1171	14.00	25.00	28.00	23.00
1301	100.00*	< 100.00*	*	*
1481	8.00	15.00	*	*
1521	11.00	17.00	10.00	17.00
1571	10.00	20.00	10.00	20.00
1681	70.00*	90.00	*	*
1701	7.70	22.00	5.10	16.00
2121	40.00	100.00	20.00	20.00
2301	10.00*	14.00	10.00*	15.00
2521	7.00	20.00	3.00	17.00
2721	370.00*	100.00	*	*
2911	9.00	7.00	*	*
3521	6.00	13.00	7.00	11.00
3561	50.00	100.00	80.00*	100.00*

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 34: EVALUATED DATA FOR CHROMIUM AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR CHROMIUM (DIRECT ASPIRATION) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		7.40	15.00	7.40	15.00
LAB/AN	LAB REJECTED				
3931		100.00*	80.00	340.00*	80.00*
3971		0.00*	0.00*	0.00*	0.00*
4401		50.00*	< 50.00*	50.00*	< 50.00*
4431		12.20	47.00	21.50	60.00*
4441		250.00*	280.00*	*	*
4451		10.00	20.00	10.00	20.00
4461		*	10.00	20.00	20.00
4471		1.60*	23.00	4.70	25.00
4501		13.00	30.00	7.00	21.00
4531		20.00*	25.00	*	*
4561		10.00*	20.00	10.00*	20.00
4581		18.00	39.00	30.00	40.00
4591		0.00*	0.00*	0.00*	0.00*
4641		0.00*	16.00	14.00	16.00
4671		0.00*	0.00*	10.00	20.00
4681		10.00	20.00	10.00	20.00
4711		105.00*	0.00*	115.00*	0.00*
4721		16.00	23.00	24.00	31.00
4741		40.00	20.00	*	*
4761		0.00*	50.00	0.00*	40.00
4771		8.00	17.00	7.50	18.00
4811		10.00*	20.00	10.00*	< 10.00*
4831		25.00	25.00	*	*
4841		0.00*	0.00*	*	*
4871		10.00*	3.00	*	*
4911		8.00	15.00	7.60	14.00
4922		28.00	30.00	24.00	34.00
4941		0.00*	0.00*	0.00*	0.00*
5011		300.00*	400.00*	*	*
5041		40.00	30.00	10.00	30.00
5181		10.00	10.00	10.00	10.00
5291		18.00	25.00	18.00	25.00
5361		11.00	16.00	*	*
5511		7.00	16.00	10.00	20.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 35: EVALUATED DATA FOR COPPER IN DISTILLED WATER

LAB/AN	LAB REJECTED	AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		302.00	60.00	75.00	332.00
1091		370.00	50.00	70.00	290.00
1121		300.00	55.00	80.00	335.00
1131		293.00	60.00	73.00	326.00
1161		304.00	316.00*	56.00	346.00
1221		302.00	55.00	78.00	330.00
1241		300.00	64.00	78.00	328.00
1381		280.00	60.00	70.00	320.00
1571		300.00	60.00	80.00	340.00
1701		304.00	61.00	77.00	335.00
1901		298.00	58.00	75.00	326.00
2121		299.00	62.00	77.00	329.00
2301		314.00	70.00	68.00	325.00
2491		290.00	20.00	40.00	320.00
2501		280.00	54.00	69.00	310.00
2621		300.00	50.00	80.00	320.00
2731		324.00	60.00	60.00	350.00
3091		350.00	80.00	100.00	380.00
3111		270.00	58.00	71.00	252.00
3221		310.00	80.00	80.00	310.00
3381	*	960.00*	780.00*	780.00*	960.00*
3521		300.00	59.00	74.00	340.00
4021		280.00	100.00	110.00	310.00
4401		311.00	59.00	71.00	339.00
4421		270.00	50.00	62.00	283.00
4451		300.00	60.00	80.00	280.00
4461		280.00	60.00	70.00	320.00
4471	*	687.00*	129.00*	165.00*	779.00*
4501		305.00	115.00	155.00*	362.00
4571	*	203.00*	36.00*	52.00*	203.00*
4581		243.00	42.00	48.00	261.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 35: EVALUATED DATA FOR COPPER IN DISTILLED WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		302.00	60.00	75.00	332.00
LAB/AN	LAB REJECTED				
4601		266.00	39.00	64.00	278.00
4631		19.00*	50.00	62.00	22.00*
4651		290.00	70.00	80.00	310.00
4671	*	210.00*	25.00*	60.00*	250.00*
4681		300.00	60.00	80.00	320.00
4691	*	510.00*	100.00*	110.00*	500.00*
4701		300.00	60.00	77.00	321.00
4721		219.00	45.00	64.00	250.00
4731	*	210.00*	40.00*	50.00*	250.00*
4811		270.00	70.00	90.00	360.00
4821		365.00	90.00	90.00	380.00
4941		300.00	58.00	71.00	330.00
4971		305.00	72.00	76.00	350.00
4981		300.00	110.00	75.00	285.00
5001		320.00	50.00	70.00	320.00
5031		275.00	55.00	70.00	315.00
5061		280.00	55.00	70.00	300.00
5071		330.00	80.00	100.00	360.00
5291		300.00	57.00	70.00	310.00
5501		300.00	50.00	76.00	330.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 36: EVALUATED DATA FOR COPPER IN NATURAL WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		302.00	60.00	75.00	332.00
LAB/AN	LAB REJECTED				
1091		290.00	50.00	70.00	290.00
1121		300.00	60.00	75.00	330.00
1131		293.00	60.00	73.00	324.00
1161		314.00	356.00*	58.00	350.00
1221		300.00	55.00	75.00	330.00
1241		229.00	36.00	57.00	258.00
1381		270.00	50.00	60.00	310.00
1571		330.00	70.00	80.00	340.00
1701		302.00	59.00	76.00	322.00
1901		291.00	56.00	68.00	324.00
2121		293.00	62.00	82.00	340.00
2301		308.00	61.00	70.00	336.00
2491		290.00	20.00	40.00	320.00
2501		252.00	44.00	71.00	277.00
2621		300.00	50.00	100.00	340.00
2731		324.00	60.00	60.00	350.00
3091		340.00	100.00	120.00*	390.00
3111		263.00	54.00	74.00	260.00
3221		308.00	78.00	78.00	286.00
3381	*	440.00*	170.00*	170.00*	480.00*
3521		300.00	65.00	80.00	330.00
4021		330.00	90.00	110.00	350.00
4401		289.00	55.00	66.00	322.00
4421		207.00	45.00	49.00	244.00
4451		300.00	60.00	60.00	270.00
4461		280.00	60.00	80.00	320.00
4471	*	635.00*	125.00*	160.00*	682.00*
4501	*	362.00*	98.00*	155.00*	363.00*
4571	*	205.00*	37.00*	52.00*	205.00*
4581		238.00	42.00	41.00	255.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 36: EVALUATED DATA FOR COPPER IN NATURAL WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		302.00	60.00	75.00	332.00
LAB/AN	LAB REJECTED				
4601		291.00	64.00	77.00	303.00
4631		20.00*	50.00	62.00	22.00*
4651		290.00	70.00	80.00	310.00
4671		224.00	50.00	75.00	224.00
4681		300.00	60.00	70.00	320.00
4691	*	530.00*	120.00*	130.00*	520.00*
4701		296.00	67.00	67.00	331.00
4721		225.00	39.00	59.00	258.00
4731		170.00*	55.00	65.00	190.00
4811		255.00	55.00	55.00	274.00
4821		315.00	70.00	80.00	315.00
4941		300.00	59.00	76.00	330.00
4971		320.00	62.00	81.00	340.00
4981		300.00	80.00	75.00	290.00
5001		300.00	50.00	70.00	320.00
5031		280.00	60.00	70.00	300.00
5061		280.00	55.00	70.00	300.00
5071		330.00	80.00	100.00	360.00
5291		300.00	57.00	70.00	314.00
5501		290.00	52.00	68.00	322.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 37: EVALUATED DATA FOR COPPER AT A LOW CONCENTRATION in ug/liter

EVALUATED DATA FOR COPPER (CONCENTRATION TECHNIQUE)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		7.50	12.00	7.50	12.00
LAB/AN	LAB REJECTED				
102		13.00	19.00	*	9.00
106		< 1.00*	13.00	6.00	9.00
110		16.00	22.00	10.00	17.00
111		10.00	11.00	3.00	6.00
112		8.00	10.00	8.00	11.00
195		5.00	10.00	*	*
249		7.00	13.00	6.00	9.00
441		7.80	13.00	8.10	13.00
442		16.00	24.00	6.00	7.00
443		23.00	35.00*	15.00*	29.00*
462		9.00	13.00	8.00	12.00
475		6.00	10.00	*	*
503		13.00	18.00	7.00	13.00
539		68.00*	80.00*	60.00*	80.00*

EVALUATED DATA FOR COPPER (EXTRACTION TECHNIQUE)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
101		7.00	9.50	6.90	8.90
103		18.00	19.00	2.00*	1.00
109		15.00	18.00	16.00	17.00
115		29.00*	21.00	30.00*	9.00
137		26.00*	33.00	17.00	26.00
138		1.20	1.10	1.00	2.00
145		12.00	14.00	8.00	9.00
147		9.40	4.40	6.20	12.00
152		9.00	13.00	9.00	13.00
204		8.00	14.00	13.00	17.00
259		10.00	12.00	11.00	12.00
267		9.00	14.00	11.00	15.00
279		15.00	14.00	10.00	10.00
282		7.50	7.80	5.70	9.70
283		< 25.00*	< 25.00*	< 25.00*	< 25.00*
311		7.00	12.00	7.00	13.00
329		2.00	< 1.00*	10.00	< 1.00*
338		*	*	14.50	44.50*
356		< 50.00*	*	< 50.00*	*

* = REJECTED VALUE

TABLE 37: EVALUATED DATA FOR COPPER AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR COPPER (EXTRACTION TECHNIQUE) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		7.50	12.00	7.50	12.00
LAB/AN	LAB REJECTED				
393		100.00*	28.00	11.00	15.00
422		14.00	19.00	13.00	18.00
446		6.50	9.00	4.50	8.50
448		20.00	20.00	20.00	20.00
451		8.00	13.00	12.00	12.00
453		8.00	12.00	*	*
470		7.40	13.00	7.00	9.60
475		9.00	12.00	12.00	15.00
478		20.00	27.80	*	*
479		7.00	10.00	7.00	10.00
480		9.20	13.00	13.00	17.00
488		15.00	18.00	11.00	20.00
492		3.00	2.00	8.00	7.00
493		8.00	12.00	10.00	11.00
496		1.80	2.60	2.00	2.80
497		10.00	4.00	10.00	7.00
498		8.00	13.00	13.00	16.00
499		1.30	1.10	1.10	1.20
506		7.00	11.00	7.00	11.00
507		7.00	10.00	7.00	10.00
550		10.00	12.00	8.00	7.00
551		8.40	15.00	7.70	13.00

EVALUATED DATA FOR COPPER (DIRECT ASPIRATION)

1131		7.00	13.00	6.00	12.00
1161		6.00	7.00	4.00	8.00
1171		8.60	16.00	12.00	17.00
1241		16.00	18.00	0.00*	0.00*
1481		13.00	17.00	*	*
1501		30.00	40.00	*	*
1571		10.00	20.00	10.00	20.00
1681		50.00	70.00	*	*
1691		20.00	30.00	*	*
1701		8.60	12.00	7.20	11.00
1901		7.00	29.00	6.00	0.00*

* = REJECTED VALUE

TABLE 37: EVALUATED DATA FOR COPPER AT A LOW CONCENTRATION (continued)
in ug/liter

EVALUATED DATA FOR COPPER (DIRECT ASPIRATION) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		7.50	12.00	7.50	12.00
LAB/AN	LAB REJECTED				
2121		15.00	21.00	15.00	26.00
2501		*	*	8.00	14.00
2521		11.00	12.00	11.00	10.00
2621		20.00	< 10.00*	10.00	20.00
2721		1.50	1.10	*	*
2911		38.00	41.00	*	*
3221		11.00	24.00	10.00	20.00
3381		700.00*	700.00*	*	*
3521		14.00	15.00	11.00	17.00
3561		*	70.00	*	80.00*
3741		10.00	20.00	10.00	10.00
3971		10.00	0.00*	10.00	0.00*
4021		70.00*	30.00	50.00	40.00
4441		88.00*	20.00	*	*
4451		10.00	10.00	10.00*	10.00
4471		9.00	20.00	37.00	28.00
4501		17.00	26.50	15.00	27.50
4541		20.00	60.00	*	95.00*
4561		10.00	20.00	10.00	20.00
4571		36.00	51.00	37.00	53.00
4581		0.00*	0.00*	1.00	11.00
4631		2.00	1.00	2.50	2.00
4641		0.00*	11.00	11.00	26.00
4661		50.00	50.00	30.00	30.00
4681		10.00*	10.00	10.00*	10.00
4721		6.00	0.30	2.00	0.20
4741		10.00	15.00	*	*
4761		20.00	20.00	20.00	30.00
4771		10.00	10.00	9.50	9.50
4831		22.00	22.00	*	*
4841		10.00	20.00	*	*
4891		4.00	11.00	7.00	9.00
4901		35.00	50.00	50.00	56.00
4911		8.90	11.00	8.90	13.00
4941		8.00	14.00	0.00*	0.00*
5011		175.00*	250.00*	*	*
5041		21.00	16.00	17.00	22.00
5181		10.00	20.00	10.00	0.00*
5291		10.00	15.00	10.00	15.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 38: EVALUATED DATA FOR IRON IN DISTILLED WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		840.00	350.00	438.00	700.00
LAB/AN	LAB REJECTED				
1031		740.00	340.00	400.00	610.00
1151		874.00	399.00	482.00	734.00
1221		850.00	357.00	440.00	672.00
1371		1000.00	200.00	240.00*	500.00*
1451		840.00	350.00	430.00	700.00
1571		850.00	350.00	430.00	680.00
1901		851.00	348.00	438.00	709.00
2121		784.00	314.00	388.00	660.00
2301		842.00	1320.00*	521.00	740.00
2491		910.00	390.00	500.00	840.00
2501		830.00	330.00	420.00	680.00
2521		830.00	400.00	430.00	730.00
2621		890.00	350.00	490.00	700.00
2791		960.00	590.00*	410.00	680.00
2821		821.00	329.00	412.00	694.00
3241		810.00	400.00	360.00	690.00
3291		783.00	290.00	408.00	658.00
3381		890.00	350.00	450.00	740.00
3561	*	1100.00*	1500.00*	1000.00*	1000.00*
3741		830.00	350.00	440.00	710.00
4221		1139.00*	315.00	412.00	954.00*
4401		831.00	352.00	431.00	678.00
4421		747.00	310.00	382.00	617.00
4431		740.00	280.00	340.00	710.00
4461		770.00	330.00	400.00	660.00
4491		730.00	290.00	380.00	570.00
4501		815.00	583.00*	860.00*	658.00
4551		900.00	450.00	550.00	770.00
4561		960.00	420.00	500.00	790.00
4641		825.00	337.00	411.00	667.00
4651		840.00	310.00	470.00	690.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 38: EVALUATED DATA FOR IRON IN DISTILLED WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		840.00	350.00	438.00	700.00
LAB/AN	LAB REJECTED				
4671	*	620.00*	250.00*	320.00*	450.00*
4681		870.00	360.00	440.00	670.00
4691	*	1000.00*	480.00*	650.00*	980.00*
4711		1000.00	430.00	480.00	760.00
4721		813.00	339.00	434.00	698.00
4731		980.00	370.00	400.00	740.00
4771		825.00	350.00	700.00*	700.00
4801		901.00	300.00	450.00	700.00
4821		760.00	314.00	430.00	620.00
4891		850.00	344.00	428.00	697.00
4911		828.00	350.00	430.00	693.00
4921		792.00	366.00	436.00	732.00
4941		900.00	400.00	400.00	700.00
4971		710.00	260.00	400.00	670.00
4981		810.00	500.00	475.00	687.00
5031		800.00	290.00	385.00	566.00
5071		900.00	400.00	450.00	700.00
5371	*	0.80*	0.22*	0.42*	0.67*
5511		845.00	379.00	494.00	712.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 39: EVALUATED DATA FOR IRON IN NATURAL WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		840.00	350.00	438.00	700.00
LAB/AN	LAB REJECTED				
1031		717.00	340.00	415.00	660.00
1151		859.00	535.00	467.00	704.00
1221		830.00	351.00	425.00	673.00
1371		1000.00	200.00	350.00	460.00
1451		840.00	360.00	440.00	720.00
1571		850.00	330.00	390.00	690.00
1901		848.00	352.00	435.00	704.00
2121		743.00	322.00	404.00	644.00
2301		834.00	556.00	504.00	684.00
2491		900.00	400.00	490.00	830.00
2501		910.00	450.00	450.00	715.00
2521		730.00	290.00	390.00	640.00
2621		920.00	360.00	470.00	730.00
2791		1200.00*	390.00	730.00	560.00
2821		849.00	368.00	479.00	710.00
3241		910.00	390.00	400.00	690.00
3291		900.00	367.00	516.00	746.00
3381		890.00	350.00	450.00	740.00
3561	*	1100.00*	1300.00*	1100.00*	1000.00*
3741		830.00	340.00	430.00	690.00
4221		1212.00*	312.00	549.00	826.00
4401		838.00	350.00	507.00	747.00
4421		819.00	297.00	382.00	615.00
4431	*	2440.00*	1890.00*	2080.00*	2000.00*
4461		820.00	320.00	700.00	600.00
4491		740.00	280.00	360.00	600.00
4501		815.00	577.00	991.00*	682.00
4551		900.00	425.00	450.00	900.00
4561		890.00	390.00	490.00	760.00
4641		1010.00	518.00	600.00	855.00
4651		820.00	350.00	460.00	690.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 39: EVALUATED DATA FOR IRON IN NATURAL WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		840.00	350.00	438.00	700.00
LAB/AN	LAB REJECTED				
4671	*	600.00*	230.00*	330.00*	450.00*
4681		840.00	350.00	440.00	690.00
4691		1050.00	500.00	690.00	1000.00*
4711		970.00	540.00	490.00	770.00
4721		824.00	330.00	432.00	694.00
4731		990.00	380.00	480.00	780.00
4771	*	600.00*	75.00*	100.00*	450.00*
4801	*	1255.00*	702.00*	851.00*	1002.00*
4821		865.00	330.00	464.00	710.00
4891		865.00	370.00	445.00	700.00
4911		832.00	352.00	435.00	694.00
4921		702.00	320.00	386.00	623.00
4941	*	1400.00*	1000.00*	1100.00*	1400.00*
4971		870.00	270.00	320.00	760.00
4981		825.00	555.00	565.00	738.00
5031		736.00	276.00	326.00	531.00
5071		800.00	300.00	420.00	670.00
5371	*	0.86*	0.28*	0.43*	0.73*
5511		858.00	391.00	502.00	729.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 40: EVALUATED DATA FOR IRON AT A LOW CONCENTRATION in ug/liter

EVALUATED DATA FOR IRON (CONCENTRATION TECHNIQUE)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		24.00	10.00	24.00	10.00
LAB/AN	LAB REJECTED				
106		47.00	21.00	*	*
110		31.00	15.00	0.00*	0.00*
111		20.00	10.00	20.00	10.00
112		46.00	30.00	*	*
249		45.00	36.00	25.00	15.00
441		25.00	10.00	27.00	9.60
442		29.00	19.00	10.00	0.00*
462		67.00	40.00	14.00	19.00
475		18.00	9.00	*	*
503		50.00	36.00	41.00	22.00
539		360.00*	530.00*	*	*

EVALUATED DATA FOR IRON (EXTRACTION TECHNIQUE)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
101		18.00	10.00	*	*
115		37.00	19.00	40.00	27.00
204		22.00	12.00	32.00	24.00
259		30.00	16.00	30.00	*
267		32.00	39.00	40.00	44.00
279		115.00*	40.00	*	*
282		*	13.00	*	55.00
329		378.00*	48.00	96.00	*
338		37.00	18.00	48.00	80.00
356		*	< 50.00*	*	< 50.00*
393		43.00	15.00	93.00	27.00
422		45.00	28.00	100.00	118.00
446		19.00	5.00	*	*
448		30.00	20.00	*	20.00
451		30.00	23.00	29.00	24.00
453		40.00	56.00	*	*
457		23.00	36.00	25.00	37.00
466		60.00	60.00	65.00	75.00
470		22.00	11.00	22.00	12.00
475		20.00	11.00	*	*
478		50.00	38.00	*	*

* = REJECTED VALUE

TABLE 40: EVALUATED DATA FOR IRON AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR IRON (EXTRACTION TECHNIQUE) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		24.00	10.00	24.00	10.00
LAB/AN	LAB REJECTED				
479		25.00	10.00	25.00	10.00
480		30.00	16.00	*	*
481		39.00	13.00	34.00	60.00
488		29.00	16.00	20.00	*
490		36.00	23.00	56.00	51.00
492		34.00	37.00	0.00*	0.00*
493		22.00	10.00	22.00	10.00
496		5.50	2.90	5.30	3.10
497		11.00	30.00	16.00	54.00
498		60.00	79.00*	83.00	74.00
499		2.80	1.70	2.00	0.90
506		29.00	16.00	29.00	16.00
550		38.00	19.00	17.00	21.00
551		28.00	9.50	30.00	11.00

EVALUATED DATA FOR IRON (DIRECT ASPIRATION)

1021	75.00	100.00	*	*
1031	48.00	54.00	49.00	49.00
1091	400.00*	200.00	200.00	200.00
1131	26.00	13.00	10.00	10.00
1171	173.00	176.00	170.00	209.00
1371	180.00	200.00	100.00*	140.00
1451	30.00	10.00	30.00	10.00
1501	60.00	30.00	*	*
1521	25.00	12.00	41.00	30.00
1571	20.00	10.00	20.00	10.00
1681	360.00*	420.00*	*	*
1691	80.00	60.00	*	*
1701	19.00	7.40	55.00	60.00
1901	26.00	23.00	30.00	14.00
2121	33.00	8.30	25.00	0.00*
2501	*	*	90.00	50.00
2821	174.00	*	170.00	*

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 40: EVALUATED DATA FOR ~~IRON AT A LOW~~ CONCENTRATION (continued)
in ug/liter

EVALUATED DATA FOR IRON (DIRECT ASPIRATION) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		24.00	10.00	24.00	10.00
LAB/AN	LAB REJECTED				
2911		133.00	66.00	*	*
3091		80.00	< 50.00*	130.00	60.00
3221		30.00	30.00	40.00	40.00
3521		27.00	14.00	28.00	17.00
3561		300.00*	*	200.00	*
3971		10.00	0.00*	50.00	0.00*
4021		70.00	70.00	60.00	60.00
4221		45.00	28.00	100.00	118.00
4401		50.00*	< 50.00*	27.00	25.00
4431		250.00*	200.00	500.00*	1635.00*
4441		50.00	47.00	*	*
4471		10.00	4.00	34.00	105.00
4501		49.10	22.00	49.00	32.00
4581		64.00	42.00	296.00*	374.00
4631		20.00	< 20.00*	21.00	*
4641		0.00*	30.00	187.00	208.00
4651		*	*	20.00	10.00
4681		30.00	20.00	40.00	30.00
4691		100.00	*	110.00	*
4721		29.00	8.00	24.00	15.00
4741		94.00	65.00	*	*
4761		60.00	40.00	780.00*	600.00
4771		76.00	76.00	*	*
4801		*	*	332.00*	331.00
4831		19.00	19.00	*	*
4891		22.00	4.00	23.00	15.00
4911		29.00	10.00	37.00	17.00
4941		0.00*	0.00*	600.00*	600.00
5011		600.00*	350.00*	*	*
5071		50.00	60.00	30.00	45.00
5181		100.00	0.00*	100.00	0.00*
5291		16.00	6.00	20.00	6.00
5391		*	*	380.00*	480.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY DIRECT ASPIRATION

TABLE 41: EVALUATED DATA FOR LEAD IN DISTILLED WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		367.00	101.00	84.00	334.00
LAB/AN	LAB REJECTED				
1031		578.00*	*	*	520.00*
1091		300.00	50.00	70.00	280.00
1121		310.00	100.00	100.00	290.00
1131		350.00	90.00	70.00	320.00
1161		425.00	99.00	53.00	356.00
1171		*	69.00	51.00	*
1221		395.00	130.00	135.00	363.00
1241		387.00	100.00	83.00	326.00
1371		760.00*	150.00	130.00	870.00*
1381		400.00	100.00	100.00	300.00
1571		400.00	93.00	70.00	290.00
1901		385.00	145.00	110.00	345.00
2041		415.00	82.00	150.00	361.00
2121		340.00	101.00	82.00	302.00
2491		280.00	100.00	85.00	300.00
2501		380.00	170.00	*	340.00
2521		500.00	134.00	104.00	500.00*
2671		350.00	110.00	130.00	280.00
2911		391.00	200.00	125.00	326.00
3221		400.00	94.00	94.00	400.00
3381		350.00	130.00	130.00	310.00
3521		350.00	82.00	65.00	310.00
3741		400.00	90.00	90.00	390.00
4421	*	273.00*	50.00*	50.00*	220.00*
4451		380.00	110.00	90.00	330.00
4561		410.00	120.00	100.00	390.00
4571		314.00	391.00*	125.00	314.00
4581		466.00	95.00	111.00	74.00*
4601		364.00	84.00	27.00	309.00
4631		372.00	93.00	65.00	295.00
4641		373.00	73.00	103.00	326.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY DIRECT ASPIRATION

TABLE 41: EVALUATED DATA FOR LEAD IN DISTILLED WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		367.00	101.00	84.00	334.00
LAB/AN	LAB REJECTED				
4651	*	950.00*	480.00*	240.00*	710.00*
4671		322.00	25.00	25.00	255.00
4721		451.00	160.00	155.00	402.00
4741		450.00	200.00	190.00	400.00
4761		640.00*	50.00	540.00*	370.00
4771		289.00	55.00	40.00	220.00
4811		348.00	120.00	99.00	340.00
4821		400.00	100.00	100.00	370.00
4831		380.00	142.00	142.00	333.00
4891		362.00	125.00	96.00	346.00
4901	*	630.00*	290.00*	240.00*	500.00*
5011	*	3500.00*	1850.00*	1600.00*	1650.00*
5041	*	330.00*	0.00*	0.00*	250.00*
5061		370.00	110.00	*	340.00
5181		340.00	55.00	40.00	120.00*
5291		360.00	113.00	90.00	350.00
5401		418.00	147.00	129.00	*
5501		333.00	150.00	115.00	330.00
5511		359.00	85.00	*	319.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY DIRECT ASPIRATION

TABLE 42: EVALUATED DATA FOR LEAD IN NATURAL WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		367.00	101.00	84.00	334.00
LAB/AN	LAB REJECTED				
1031		580.00	*	*	530.00
1091		270.00	30.00	50.00	270.00
1121		330.00	100.00	100.00	310.00
1131		350.00	90.00	70.00	320.00
1161		420.00	103.00	60.00	376.00
1171		391.00	74.00	63.00	245.00
1221		370.00	112.00	115.00	350.00
1241		331.00	91.00	95.00	283.00
1371		650.00*	120.00	120.00	500.00
1381		400.00	100.00	100.00	300.00
1571		420.00	100.00	73.00	330.00
1901		378.00	132.00	107.00	352.00
2041		420.00	82.00	142.00	372.00
2121		353.00	101.00	76.00	302.00
2491		280.00	100.00	85.00	350.00
2501		370.00	135.00	115.00	285.00
2521		486.00	108.00	90.00	486.00
2671		360.00	170.00	80.00	350.00
2911	*	*	*	*	*
3221		400.00	94.00	94.00	400.00
3381		350.00	130.00	130.00	310.00
3521		350.00	84.00	69.00	310.00
3741		420.00	100.00	100.00	420.00
4421	*	183.00*	33.00*	23.00*	150.00*
4451		250.00	110.00	80.00	350.00
4561		430.00	130.00	140.00	380.00
4571		322.00	390.00*	127.00	320.00
4581		490.00	97.00	110.00	65.00*
4601		420.00	253.00*	197.00	475.00
4631		372.00	98.00	68.00	300.00
4641		397.00	110.00	154.00	419.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY DIRECT ASPIRATION

TABLE 42: EVALUATED DATA FOR LEAD IN NATURAL WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		367.00	101.00	84.00	334.00
LAB/AN	LAB REJECTED				
4651	*	950.00*	*	*	860.00*
4671		230.00	110.00	100.00	370.00
4721		454.00	160.00	148.00	402.00
4741	*	*	*	*	*
4761	*	680.00*	430.00*	540.00*	410.00*
4771		342.00	53.00	35.00	200.00
4811		357.00	128.00	95.00	330.00
4821		320.00	100.00	100.00	400.00
4831	*	*	*	*	*
4891		408.00	86.00	108.00	356.00
4901	*	740.00*	235.00*	220.00*	550.00*
5011		3500.00*	*	*	1650.00*
5041	*	270.00*	0.00*	0.00*	140.00*
5061		370.00	110.00	*	340.00
5181		380.00	75.00	40.00	140.00
5291		360.00	110.00	87.00	360.00
5401		517.00	194.00	183.00	*
5501		326.00	113.00	95.00	346.00
5511		349.00	75.00	*	313.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 43: EVALUATED DATA FOR LEAD AT A LOW CONCENTRATION in ug/liter

EVALUATED DATA FOR LEAD (CONCENTRATION TECHNIQUE)

	DISTILLED WATER		NATURAL WATER	
	AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L	37.00	25.00	37.00	25.00
LAB/AN LAB REJECTED				
102	50.00	30.00	30.00	20.00
106	35.00	25.00	35.00	23.00
111	50.00	40.00	40.00	30.00
112	36.00	26.00	32.00	23.00
249	41.00	23.00	41.00	23.00
441	45.00	29.00	47.00	30.00
442	21.00	9.00	14.00	10.00
443	60.00	47.00	75.00	60.00
462	36.00	24.00	46.00	24.00
475	35.00	25.00	*	*
503	39.00	28.00	32.00	23.00
539	97.00*	81.00*	80.00	75.00

EVALUATED DATA FOR LEAD (EXTRACTION TECHNIQUE)

101	33.00	32.00	37.00	26.00
109	37.00	30.00	37.00	30.00
115	50.00	32.00	41.00	12.00
138	4.30	3.00	9.80	9.80
145	35.00	24.00	33.00	25.00
147	38.00	25.00	41.00	38.00
150	30.00	30.00	*	*
152	35.00	16.00	31.00	20.00
168	140.00*	90.00*	*	*
190	21.00	20.00	21.00	20.00
195	37.00	27.00	*	*
204	*	43.00	66.00	45.00
259	33.00	21.00	33.00	21.00
262	25.00	45.00	38.00	48.00
267	36.00	23.00	37.00	23.00
272	0.90	0.60	*	*
279	85.00	35.00	80.00	35.00
282	34.00	22.00	39.00	26.00

* = REJECTED VALUE

TABLE 43: EVALUATED DATA FOR LEAD AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR LEAD (EXTRACTION TECHNIQUE) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		37.00	25.00	37.00	25.00
LAB/AN	LAB REJECTED				
311		9.00	6.00	8.00	6.00
322		47.00	34.50	47.00	34.50
329		25.00	21.00	46.00	12.00
338		33.00	34.50	38.00	43.50
393		37.00	13.00	43.00	20.00
422		0.00*	0.00*	0.00*	5.00
446		41.00	27.00	25.00	7.00
447		45.00	33.00	27.00	17.00
448		50.00	50.00	50.00	50.00
450		11.00	8.20	9.00	7.40
451		45.00	29.00	45.00	29.00
453		52.00	40.00	*	*
466		32.00	22.00	25.00	25.00
468		52.00	32.00	58.00	42.00
470		52.00	22.00	42.00	20.00
471		30.00	30.00	50.00	30.00
475		26.00	19.00	25.00	15.00
478		62.00	36.00	62.00	34.00
479		35.00	25.00	35.00	25.00

EVALUATED DATA FOR LEAD (DIRECT ASPIRATION)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
1131		40.00	20.00	40.00	20.00
1161		30.00*	< 30.00*	30.00*	< 30.00*
1171		19.00	12.00	25.00	13.00
1241		50.00	26.00	41.00	41.00
1301		500.00*	< 500.00*	*	*
1371		20.00	35.00	25.00	35.00
1571		39.00	21.00	35.00	23.00
2041		62.00	*	*	*
2121		12.00	19.00	12.00	19.00
2301		150.00*	< 150.00*	150.00*	< 150.00*

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 43: EVALUATED DATA FOR LEAD AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR LEAD (DIRECT ASPIRATION) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		37.00	25.00	37.00	25.00
LAB/AN	LAB REJECTED				
2501		*	*	80.00	50.00
2521		46.00	29.00	39.00	21.00
2911		150.00	100.00	*	*
3091		100.00*	< 100.00*	100.00*	< 100.00*
3521		28.00	24.00	32.00	22.00
3741		10.00	*	20.00	*
3971		0.00*	0.00*	0.00*	0.00*
4401		200.00*	< 200.00*	200.00*	< 200.00*
4441		50.00*	< 50.00*	*	*
4451		60.00	30.00	50.00	30.00
4551		400.00*	< 400.00*	400.00*	< 400.00*
4561		80.00	60.00	90.00	70.00
4571		391.00*	126.00	395.00*	128.00
4581		90.00	92.00	91.00	91.00
4601		84.00	27.00	187.00	140.00
4641		0.00*	5.00	65.00	88.00
4651		380.00*	280.00*	240.00	100.00
4671		0.00*	0.00*	60.00	60.00
4721		91.00	45.00	101.00	35.00
4741		10.00	5.50	*	*
4761		120.00	290.00*	210.00	330.00*
4771		25.00	23.00	25.00	20.00
4811		49.00	32.00	46.00	33.00
4821		100.00	< 100.00*	130.00	< 100.00*
4831		47.00	47.00	*	*
4841		0.00*	0.00*	*	*
4891		29.00	15.00	56.00	29.00
4901		210.00*	135.00	235.00	70.00
5011		900.00*	400.00*	*	*
5041		0.00*	0.00*	50.00	70.00
5071		10.00*	< 10.00*	10.00*	< 10.00*
5181		15.00	10.00	10.00	10.00
5291		40.00	30.00	40.00	30.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY DIRECT ASPIRATION

TABLE 44: EVALUATED DATA FOR MANGANESE IN DISTILLED WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		426.00	84.00	106.00	469.00
LAB/AN	LAB REJECTED				
1011		408.00	82.00	105.00	447.00
1031		767.00*	99.00	140.00	873.00*
1121		450.00	100.00	120.00	490.00
1131		428.00	85.00	107.00	469.00
1221		405.00	75.00	105.00	448.00
1371		420.00	88.00	84.00	450.00
1381		400.00	70.00	100.00	450.00
1521		440.00	90.00	115.00	490.00
1901		441.00	88.00	103.00	483.00
2121	*	337.00*	67.00*	67.00*	374.00*
2491		400.00	80.00	80.00	470.00
2501		390.00	76.00	90.00	435.00
2521		400.00	80.00	120.00	280.00*
2621		450.00	100.00	120.00	480.00
2791		400.00	80.00	117.00	400.00
2821		458.00	93.00	116.00	516.00
3221		420.00	90.00	120.00	460.00
3241		400.00	55.00	80.00	530.00
3381		380.00	80.00	90.00	430.00
3521		410.00	85.00	100.00	450.00
3561	*	510.00*	270.00*	300.00*	600.00*
3741	*	880.00*	150.00*	200.00*	960.00*
3931	*	630.00*	200.00*	170.00*	720.00*
3971	*	650.00*	130.00*	150.00*	650.00*
4021		420.00	80.00	120.00	460.00
4451		410.00	80.00	90.00	410.00
4471		430.00	92.00	122.00	507.00
4491		370.00	70.00	90.00	410.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY DIRECT ASPIRATION

TABLE 44: EVALUATED DATA FOR MANGANESE IN DISTILLED WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		426.00	84.00	106.00	469.00
LAB/AN	LAB REJECTED				
4501		435.00	185.00*	210.00*	446.00
4561		420.00	80.00	100.00	480.00
4571		400.00	71.00	32.00*	399.00
4641		402.00	75.00	97.00	439.00
4651		420.00	60.00	80.00	470.00
4671		370.00	70.00	90.00	420.00
4681		450.00	100.00	120.00	490.00
4701		453.00	96.00	118.00	492.00
4711		450.00	70.00	100.00	500.00
4721		422.00	81.00	102.00	464.00
4731	*	305.00*	60.00*	77.00*	330.00*
4821		390.00	70.00	85.00	460.00
4851		434.00	93.00	114.00	477.00
4891		433.00	85.00	106.00	470.00
4941		430.00	80.00	100.00	460.00
5001		410.00	60.00	90.00	450.00
5031		425.00	80.00	105.00	480.00
5041		406.00	42.00*	61.00	456.00
5061		450.00	85.00	110.00	495.00
5071		450.00	90.00	100.00	500.00
5181		420.00	100.00	100.00	450.00
5291		415.00	82.00	100.00	450.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY DIRECT ASPIRATION

TABLE 45: EVALUATED DATA FOR MANGANESE IN NATURAL WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		426.00	84.00	106.00	469.00
LAB/AN	LAB REJECTED				
1011		377.00	85.00	109.00	464.00
1031	*	960.00*	387.00*	430.00*	1030.00*
1121		450.00	100.00	115.00	495.00
1131		423.00	82.00	104.00	451.00
1221		422.00	86.00	105.00	466.00
1371		410.00	88.00	123.00	430.00
1381		420.00	120.00	140.00	500.00
1521		450.00	88.00	118.00	496.00
1901		438.00	85.00	111.00	479.00
2121	*	354.00*	67.00*	84.00*	388.00*
2491		420.00	60.00	80.00	480.00
2501		380.00	81.00	105.00	408.00
2521		400.00	90.00	110.00	460.00
2621		450.00	100.00	110.00	500.00
2791		380.00	90.00	115.00	350.00
2821		440.00	88.00	108.00	472.00
3221		430.00	100.00	130.00	470.00
3241		450.00	120.00	140.00	530.00
3381		380.00	80.00	90.00	420.00
3521		440.00	100.00	120.00	460.00
3561		450.00	270.00*	300.00*	600.00*
3741	*	880.00*	160.00*	210.00*	980.00*
3931		450.00	70.00	100.00	500.00
3971	*	600.00*	130.00*	150.00*	660.00*
4021		420.00	90.00	110.00	460.00
4451		410.00	80.00	80.00	410.00
4471		374.00	63.00	87.00	408.00
4491		380.00	84.00	110.00	420.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY DIRECT ASPIRATION

TABLE 45: EVALUATED DATA FOR MANGANESE IN NATURAL WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		426.00	84.00	106.00	469.00
LAB/AN	LAB REJECTED				
4501		456.00	183.00*	178.00*	445.00
4561		450.00	100.00	100.00	480.00
4571		399.00	73.00	31.00*	396.00
4641		441.00	117.00	127.00	484.00
4651		420.00	60.00	80.00	470.00
4671		368.00	60.00	90.00	410.00
4681		460.00	100.00	120.00	500.00
4701		484.00	103.00	124.00	518.00
4711		450.00	70.00	100.00	500.00
4721		431.00	76.00	96.00	474.00
4731		325.00*	75.00	85.00	370.00
4821		430.00	90.00	100.00	460.00
4851		422.00	92.00	117.00	480.00
4891		439.00	87.00	112.00	479.00
4941		450.00	120.00	130.00	500.00
5001		430.00	90.00	100.00	480.00
5031		433.00	83.00	113.00	483.00
5041		437.00	82.00	90.00	471.00
5061		450.00	88.00	110.00	490.00
5071		450.00	90.00	100.00	500.00
5181		400.00	80.00	80.00	450.00
5291		405.00	80.00	100.00	450.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 46: EVALUATED DATA FOR MANGANESE AT A LOW CONCENTRATION in ug/liter

EVALUATED DATA FOR MANGANESE (CONCENTRATION TECHNIQUE)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		11.00	17.00	11.00	17.00
LAB/AN	LAB REJECTED				
102		11.00	17.00	6.00	11.00
106		12.00	18.00	*	*
110		16.00*	24.00*	0.00*	0.00
111		12.00	16.00	7.00	12.00
112		12.00	16.00	5.00	12.00
195		12.00	16.00	*	*
249		11.00	17.00	11.00	23.00
259		12.00	19.00	12.00	19.00
441		10.00	16.00	9.00	15.00
442		9.00	14.00	5.00	8.00
462		11.00	18.00	10.00	17.00
475		9.00	*	*	*
503		11.00	17.00	10.00	14.00
539		88.00*	13.00	70.00*	90.00*

EVALUATED DATA FOR MANGANESE (EXTRACTION TECHNIQUE)

147		*	14.00	17.00	16.00
204		10.00	15.00	10.00	15.00
279		80.00	70.00*	75.00	80.00
329		32.00	32.00	20.00	36.00
451		12.00	18.00	12.00	19.00
466		90.00	90.00*	60.00	60.00
475		*	15.00	*	*
479		13.00	18.00	11.00	16.00
480		11.00	18.00	*	*
493		12.00	17.00	10.00	16.00
496		2.10	3.30	2.00	3.00
497		10.00	10.00	20.00	20.00
498		3.00	8.00	3.00	12.00
507		25.00	18.00	34.00	34.00

* = REJECTED VALUE

TABLE 46: EVALUATED DATA FOR MANGANESE AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR MANGANESE (DIRECT ASPIRATION)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		11.00	17.00	11.00	17.00
LAB/AN	LAB REJECTED				
1011		9.00	12.00	11.00	12.00
1031		27.00	27.00	210.00*	220.00*
1131		12.00	18.00	9.00	16.00
1151		15.00	21.00	8.00	24.00
1171		11.00	19.00	8.00	20.00
1241		12.00	16.00	8.00	16.00
1371		10.00	22.00	7.50	22.00
1451		12.00	16.00	20.00	14.00
1501		20.00	20.00	*	*
1521		10.00	15.00	11.00	17.00
1571		10.00	20.00	10.00	20.00
1681		80.00	110.00*	*	*
1901		13.00	18.00	13.00	16.00
2121		10.00	13.00	3.40	10.00
2621		10.00	20.00	10.00	20.00
2671		13.00	20.00	17.00	16.00
2721		1.50	0.80	*	*
2731		19.00	27.00	20.00	31.00
2911		12.00	14.00	*	*
3221		10.00	10.00	10.00	10.00
3521		13.00	18.00	25.00	30.00
3561		150.00*	180.00*	120.00*	150.00*
3741		20.00	10.00	20.00	10.00
3971		0.00*	10.00	10.00	10.00
4021		20.00	10.00	10.00	10.00
4431		47.00	12.00	461.00*	397.00*
4451		80.00	90.00*	80.00*	80.00*
4461		*	20.00	50.00*	40.00
4471		24.00	25.00	24.00	20.00
4501		22.60	33.00	26.00	37.00
4561		10.00*	10.00	20.00	20.00
4571		76.00	31.00	75.00*	33.00

* = REJECTED VALUE

TABLE 46: EVALUATED DATA FOR MANGANESE AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR MANGANESE (DIRECT ASPIRATION)

	DISTILLED WATER		NATURAL WATER	
	AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L	11.00	17.00	11.00	17.00
LAB/AN LAB REJECTED				
4581	63.00	36.00	123.00*	109.00*
4631	9.00	17.00	10.00	17.00
4641	4.00	22.00	41.00*	46.00
4651	2.00	2.00	10.00	10.00
4681	20.00	20.00	20.00	20.00
4721	14.00	15.00	2.00	17.00
4771	30.00	30.00	30.00	30.00
4781	*	*	1.80	8.00
4811	11.00	11.00	10.00	10.00
4871	0.00*	20.00	7.00	3.00
4891	7.00	18.00	7.00	16.00
4901	64.00	35.00	55.00*	35.00
4921	30.00	28.00	20.00	0.00*
4941	100.00*	20.00	30.00	50.00
5061	12.00	20.00	12.00	20.00
5291	10.00	18.00	10.00	18.00
5501	25.00	25.00	16.00	20.00
5511	8.00	13.00	7.00	16.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 47: EVALUATED DATA FOR SELENIUM IN DISTILLED WATER (COLORIMETRY)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		43.00	12.00	19.00	49.00	4.70	7.80
LAB/AN	LAB REJECTED						
1011		44.00	8.90	17.00	50.00	2.90	6.80
1021		26.00	11.00	14.00	26.00	5.00	8.00
1031		1.90	1.30	1.80	1.70	1.30	1.00*
1421		39.00	12.00	20.00	45.00	3.00	5.50
1481		27.00	5.00	5.70	22.00	3.70	6.00
2041	*	45.00*	34.00*	33.00*	50.00*	14.00*	8.00*
2121		38.00	9.70	14.00	31.00	4.90	7.80
2911		35.00	13.00	19.00	41.00	5.00	8.00
3221		40.60	13.50	18.30	48.90	5.70	8.10
3291		27.00	11.00	11.00	37.00	5.00	7.00
3381	*	52.00*	21.00*	22.00*	53.00*	15.00*	12.00*
3521	*	240.00*	120.00*	130.00*	250.00*	36.00*	32.00*
4481		13.00	8.00	10.00	25.00	4.00	1.00*
4702		21.00	9.00	2.50	24.00	3.00	7.00
4721		26.00	8.20	*	23.00	3.90	7.20
4921	*	290.00*	48.00*	115.00*	320.00*	7.00*	38.00*
5041		29.00	7.40	11.00	34.00	3.00	5.20
5291		31.00	11.00	19.00	35.00	4.60	10.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 48: EVALUATED DATA FOR SELENIUM IN NATURAL WATER (COLORIMETRY)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		43.00	12.00	19.00	49.00	4.70	7.80
LAB/AN	LAB REJECTED						
1011		36.00	10.00	16.00	46.00	3.10	6.00
1021		21.00	10.00	13.00	23.00	3.00	4.00
1031		1.00	1.40	1.70	2.20	< 1.00*	< 1.00*
1421		37.00	11.00	19.00	42.00	3.80	7.20
1481	*	*	*	*	*	*	*
2041		27.00	30.00*	43.00*	58.00	*	*
2121		35.00	9.30	5.20	9.00	4.90	6.70
2911	*	*	*	*	*	*	*
3221	*	*	*	*	*	*	*
3291		17.00	6.00	16.00	31.00	6.00	3.00
3381		48.00	15.00	21.00	44.00	9.00*	18.00*
3521	*	240.00*	120.00*	120.00*	250.00*	38.00*	33.00*
4481		12.00	3.00	2.00	17.00	4.00	3.00
4702		91.00*	8.50	2.00	22.00	2.50	6.50
4721		*	12.00	13.00	24.00	4.60	5.90
4921	*	255.00*	60.00*	90.00*	285.00*	10.00*	38.00*
5041	*	*	*	*	*	*	*
5291		31.00	12.00	16.00	30.00	2.30	10.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY AA DIRECT ASPIRATION

TABLE 49: EVALUATED DATA FOR ZINC IN DISTILLED WATER

LAB/AN	LAB REJECTED	AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		281.00	56.00	70.00	310.00
1031		341.00	66.00	79.00	359.00
1091		246.00	22.00	40.00	252.00
1121		252.00	50.00	55.00	260.00
1241		282.00	59.00	75.00	310.00
1381		260.00	50.00	60.00	300.00
1451		270.00	48.00	75.00	310.00
1521		273.00	58.00	72.00	293.00
1571		300.00	60.00	80.00	310.00
2041		318.00	68.00	91.00	353.00
2121		286.00	57.00	67.00	312.00
2501		280.00	50.00	63.00	300.00
2521		272.00	40.00	59.00	460.00*
2671		280.00	53.00	71.00	300.00
2731	*	2746.00*	508.00*	746.00*	3064.00*
2821		308.00	58.00	80.00	348.00
3291		324.00	156.00*	184.00*	400.00
3381		330.00	100.00	110.00	380.00
3521		270.00	50.00	61.00	300.00
3561		360.00	120.00*	80.00	320.00
3971		330.00	60.00	80.00	380.00
4021		310.00	100.00	100.00	310.00
4401		299.00	56.00	73.00	337.00
4421		252.00	45.00	60.00	262.00
4451		340.00	90.00	110.00	340.00
4461		260.00	60.00	60.00	270.00
4471		273.00	48.00	60.00	286.00
4501		285.00	141.00*	150.00*	308.00
4591	*	130.00*	10.00*	30.00*	170.00*
4601		210.00	60.00	1030.00*	210.00
4631		281.00	57.00	65.00	315.00
4651	*	720.00*	100.00*	160.00*	800.00*
4671		260.00	50.00	70.00	285.00
4701		287.00	52.00	72.00	315.00
4721		254.00	43.00	55.00	286.00
4761		290.00	60.00	70.00	320.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY AA DIRECT ASPIRATION

TABLE 49: EVALUATED DATA FOR ZINC IN DISTILLED WATER (continued)

LAB/AN	LAB REJECTED	AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		281.00	56.00	70.00	310.00
4781	*	589.00*	110.00*	126.00*	425.00*
4811		230.00	60.00	75.00	301.00
4821		223.00	65.00	78.00	242.00
4861		280.00	52.00	66.00	307.00
4891		284.00	57.00	70.00	309.00
4911		284.00	54.00	67.00	307.00
4921		280.00	59.00	62.00	370.00
4971		230.00	46.00	55.00	270.00
4981		318.00	72.00	85.00	320.00
4991		298.00	64.00	76.00	303.00
5041		305.00	8.00	12.00*	306.00
5061		280.00	55.00	70.00	300.00
5291		242.00	35.00	43.00	265.00
5371	*	0.30*	0.06*	0.01*	0.33*
5501		290.00	50.00	70.00	306.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY AA DIRECT ASPIRATION

TABLE 50: EVALUATED DATA FOR ZINC IN NATURAL WATER

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		281.00	56.00	70.00	310.00
LAB/AN	LAB REJECTED				
1031		336.00	77.00	83.00	370.00
1091		246.00	24.00	41.00	251.00
1121		280.00	47.00	52.00	270.00
1241		224.00	38.00	46.00	243.00
1381		250.00	40.00	60.00	300.00
1451		270.00	50.00	88.00	310.00
1521		267.00	56.00	68.00	300.00
1571		280.00	60.00	70.00	310.00
2041		323.00	68.00	100.00	363.00
2121		285.00	57.00	70.00	312.00
2501		390.00*	42.00	59.00	390.00
2521		275.00	40.00	67.00	460.00*
2671		280.00	53.00	72.00	310.00
2731	*	2736.00*	616.00*	786.00*	3124.00*
2821		313.00	65.00	73.00	343.00
3291	*	381.00*	118.00*	158.00*	453.00*
3381		310.00	80.00	100.00	340.00
3521		280.00	50.00	60.00	300.00
3561		280.00	80.00	120.00	320.00
3971		340.00	70.00	90.00	370.00
4021		330.00	90.00	90.00	320.00
4401		304.00	59.00	69.00	330.00
4421		238.00	37.00	42.00	253.00
4451		330.00	90.00	100.00	330.00
4461		260.00	60.00	60.00	280.00
4471		246.00	45.00	58.00	256.00
4501		285.00	149.00*	151.00*	299.00
4591	*	150.00*	30.00*	50.00*	190.00*
4601		1250.00*	1030.00*	70.00	1250.00*
4631		282.00	60.00	67.00	315.00
4651	*	720.00*	100.00*	160.00*	780.00*
4671		65.00*	0.00*	85.00	0.00*
4701		284.00	55.00	71.00	313.00
4721		253.00	42.00	54.00	284.00
4761		290.00	70.00	80.00	330.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS BY AA DIRECT ASPIRATION

TABLE 50: EVALUATED DATA FOR ZINC IN NATURAL WATER (continued)

		AMPUL 1	AMPUL 2	AMPUL 3	AMPUL 4
INCREMENT IN UG/L		281.00	56.00	70.00	310.00
LAB/AN	LAB REJECTED				
4781		263.00	74.00	120.00	388.00
4811		235.00	55.00	66.00	295.00
4821		290.00	63.00	80.00	330.00
4861		280.00	55.00	67.00	307.00
4891		289.00	54.00	72.00	313.00
4911		277.00	63.00	75.00	314.00
4921		303.00	52.00	66.00	314.00
4971		250.00	47.00	59.00	285.00
4981		283.00	53.00	69.00	292.00
4991		282.00	74.00	78.00	301.00
5041		243.00	0.00*	21.00	282.00
5061		280.00	55.00	70.00	300.00
5291		258.00	35.00	43.00	265.00
5371	*	0.27*	0.04*	0.06*	0.30*
5501		265.00	55.00	65.00	301.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 51: EVALUATED DATA FOR ZINC AT A LOW CONCENTRATION in ug/liter

EVALUATED DATA FOR ZINC (CONCENTRATION TECHNIQUE)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		7.00	11.00	7.00	11.00
LAB/AN	LAB REJECTED				
102		110.00	90.00	*	*
106		11.00	11.00	35.00	10.00
110		50.00	30.00	20.00	150.00*
111		< 100.00*	< 100.00*	< 100.00*	< 100.00*
112		34.00	*	27.00	19.00
150		< 500.00*	< 500.00*	*	*
259		100.00	< 100.00*	100.00*	< 100.00*
443		88.00	35.00	283.00*	37.00
470		39.00	21.00	30.00	21.00

EVALUATED DATA FOR ZINC (EXTRACTION TECHNIQUE)

279	300.00	200.00*	300.00	200.00
329	288.00	50.00	213.00	53.00
446	40.00	30.00	*	*
475	40.00	20.00	*	*
493	50.00	27.00	52.00	36.00
498	0.53	0.64	0.49	0.80

EVALUATED DATA FOR ZINC (DIRECT ASPIRATION)

1011	23.00	18.00	22.00	16.00
1021	*	*	10.00	20.00
1031	30.00	38.00	50.00	58.00
1131	4.00	8.00	3.00	8.00
1171	32.00	38.00	37.00	45.00
1451	4.00	20.00	10.00	17.00
1471	13.00	14.00	14.00	12.00
1521	11.00	13.00	9.00	11.00
1571	10.00	10.00	10.00	20.00
1681	50.00	70.00	*	*
1701	4.60	9.70	0.00*	0.00*
2121	6.70	10.00	5.60	12.00
2301	6.00	20.00	6.00	15.00

* = REJECTED VALUE

USEPA METHOD STUDY 7, TRACE METALS

TABLE 51: EVALUATED DATA FOR ZINC AT A LOW CONCENTRATION (continued) in ug/liter

EVALUATED DATA FOR ZINC (DIRECT ASPIRATION) (continued)

		DISTILLED WATER		NATURAL WATER	
		AMPUL 5	AMPUL 6	AMPUL 5	AMPUL 6
INCREMENT IN UG/L		7.00	11.00	7.00	11.00
LAB/AN	LAB REJECTED				
2521		10.00	10.00	10.00	10.00
2671		7.00	5.00	3.00	3.00
3091		30.00	30.00	30.00	30.00
3221		30.00	30.00	30.00	30.00
3291		75.00*	134.00*	80.00*	95.00
3381		60.00	70.00	50.00	70.00
3521		10.00	11.00	10.00	12.00
3561		10.00	20.00	30.00	20.00
4021		50.00	10.00	70.00	10.00
4451		90.00*	110.00*	90.00*	100.00
4471		5.00	10.00	10.00	9.00
4501		5.00	15.00	4.00	14.00
4511		8.00	4.00	6.00	12.00
4541		49.00	62.00	55.00	71.00
4561		20.00	20.00	30.00	30.00
4571		115.00*	79.00*	117.00*	83.00
4581		33.00	34.00	448.00*	393.00*
4601		20.00*	20.00	970.00*	990.00*
4631		9.00	*	10.00	*
4641		0.00*	2.00	2.00	4.00
4651		20.00	40.00	20.00	40.00
4681		10.00	20.00	10.00	20.00
4721		4.00	4.00	1.00	1.00
4761		20.00	20.00	30.00	30.00
4771		18.00	9.00	16.00	8.00
4781		98.00*	97.00*	60.00	*
4811		16.00	16.00	13.00	9.00
4891		4.00	14.00	6.00	14.00
4901		17.00	35.00	8.00	4.00
4911		6.80	12.00	12.00	13.00
4921		16.00	23.00	12.00	18.00
4941		10.00	10.00	10.00	10.00
4991		11.00	18.00	11.00	21.00
5061		7.00	11.00	7.00	11.00
5071		10.00	20.00	10.00	20.00
5291		7.00	7.50	6.90	8.00
5371		0.01	0.01	0.00	0.01

* = REJECTED VALUE

APPENDIX D

STATISTICAL SUMMARY TABLES

USEPA METHOD STUDY 7, TRACE METALS

TABLE 52: STATISTICAL SUMMARY

ALUMINUM ANALYSES BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	16	18	16	15
TRUE CONC (C), UG/L	35.00	15.00	35.00	15.00
MEAN RECOVERY ($\bar{X}$)	109.44	126.30	82.44	190.45
RECOVERY (%)	312.68	842.00	235.54	1269.69
OVERALL STD DEV (S)	76.99	104.42	57.03	226.24
OVERALL REL STD DEV, %	70.35	82.68	69.18	118.79
SINGLE STD DEV, (S_r)	31.32		84.60	
ANALYST REL DEV, %	26.57		62.01	
MEDIUM YOUDEN PAIR	2	3	2	3
NUMBER OF DATA POINTS	43	43	34	38
TRUE CONC (C), UG/L	500.00	625.00	500.00	625.00
MEAN RECOVERY ($\bar{X}$)	500.18	610.37	489.56	602.65
RECOVERY (%)	100.04	97.66	97.91	96.42
OVERALL STD DEV (S)	167.25	150.04	122.14	257.65
OVERALL REL STD DEV, %	33.44	24.58	24.95	42.75
SINGLE STD DEV, (S_r)	87.96		101.03	
ANALYST REL DEV, %	15.84		18.50	
HIGH YOUDEN PAIR	1	4	1	4
NUMBER OF DATA POINTS	46	43	38	34
TRUE CONC (C), UG/L	1205.00	1004.00	1205.00	1004.00
MEAN RECOVERY ($\bar{X}$)	1195.65	985.05	1245.26	1034.50
RECOVERY (%)	99.22	98.11	103.34	103.04
OVERALL STD DEV (S)	232.25	169.58	245.50	183.81
OVERALL REL STD DEV, %	19.42	17.22	19.71	17.77
SINGLE STD DEV, (S_r)	133.72		148.90	
ANALYST REL DEV, %	12.26		13.06	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 53: STATISTICAL SUMMARY

LOW LEVEL ANALYSES FOR ALUMINUM

	DISTILLED WATER		NATURAL WATER	
BY DIRECT ASPIRATION				
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	16	18	16	15
TRUE CONC (C), UG/L	35.00	15.00	35.00	15.00
MEAN RECOVERY ($\overline{X}$)	109.44	126.30	82.44	190.45
RECOVERY (%)	312.68	842.00	235.54	1269.69
OVERALL STD DEV (S)	76.99	104.42	57.03	226.24
OVERALL REL STD DEV, %	70.35	82.68	69.18	118.79
SINGLE STD DEV, (S_r)	31.32		84.60	
ANALYST REL DEV, %	26.57		62.01	
AFTER CONCENTRATION				
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	7	5	4	4
TRUE CONC (C), UG/L	35.00	15.00	35.00	15.00
MEAN RECOVERY ($\overline{X}$)	61.71	37.40	28.00	21.75
RECOVERY (%)	176.33	249.33	80.00	45.00
OVERALL STD DEV (S)	37.60	30.79	6.27	11.24
OVERALL REL STD DEV, %	60.92	82.34	22.40	51.66
SINGLE STD DEV, (S_r)	13.55		6.75	
ANALYST REL DEV, %	27.34		27.12	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 54: STATISTICAL SUMMARY

ARSENIC ANALYSES BY COLORIMETRY

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	38	33	33	28
TRUE CONC (C), UG/L	29.00	20.00	29.00	20.00
MEAN RECOVERY ($\bar{X}$)	22.58	17.72	23.03	15.03
RECOVERY (%)	78.87	88.58	79.41	75.13
OVERALL STD DEV (S)	11.03	8.99	10.75	6.39
OVERALL REL STD DEV, %	48.85	50.78	46.69	42.56
SINGLE STD DEV, (S_r)	5.58		3.84	
ANALYST REL DEV, %	27.67		20.17	
MEDIUM YOUDEN PAIR	2	3	2	3
NUMBER OF DATA POINTS	43	42	38	35
TRUE CONC (C), UG/L	80.00	67.00	80.00	67.00
MEAN RECOVERY ($\bar{X}$)	69.30	53.83	69.16	51.89
RECOVERY (%)	86.63	80.35	86.45	77.44
OVERALL STD DEV (S)	19.81	16.96	19.84	17.08
OVERALL REL STD DEV, %	28.58	31.51	28.69	32.92
SINGLE STD DEV, (S_r)	10.42		10.13	
ANALYST REL DEV, %	16.93		16.73	
HIGH YOUDEN PAIR	1	4	1	4
NUMBER OF DATA POINTS	42	41	36	36
TRUE CONC (C), UG/L	292.00	266.00	292.00	266.00
MEAN RECOVERY ($\bar{X}$)	256.12	228.29	247.94	226.17
RECOVERY (%)	87.71	85.82	84.91	85.03
OVERALL STD DEV (S)	51.21	52.69	51.10	59.92
OVERALL REL STD DEV, %	19.99	23.08	20.61	26.49
SINGLE STD DEV, (S_r)	33.29		36.61	
ANALYST REL DEV, %	13.74		15.44	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 55: STATISTICAL SUMMARY

CADMIUM ANALYSES BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	16	18	12	16
TRUE CONC (C), UG/L	1.40	2.80	1.40	2.80
MEAN RECOVERY ($\overline{X}$)	4.36	3.51	2.42	4.57
RECOVERY (%)	311.61	125.20	173.21	163.17
OVERALL STD DEV (S)	4.22	2.47	1.78	3.46
OVERALL REL STD DEV, %	96.75	70.38	73.43	75.79
SINGLE STD DEV, (S_r)	2.51		1.23	
ANALYST REL DEV, %	63.88		35.17	
MEDIUM YOUDEN PAIR	2	3	2	3
NUMBER OF DATA POINTS	43	44	44	43
TRUE CONC (C), UG/L	14.00	18.00	14.00	18.00
MEAN RECOVERY ($\overline{X}$)	16.28	18.73	16.47	19.08
RECOVERY (%)	116.28	104.04	117.61	105.98
OVERALL STD DEV (S)	6.12	8.08	6.13	6.31
OVERALL REL STD DEV, %	37.59	43.16	37.25	33.09
SINGLE STD DEV, (S_r)	2.99		2.59	
ANALYST REL DEV, %	17.07		14.56	
HIGH YOUDEN PAIR	1	4	1	4
NUMBER OF DATA POINTS	44	44	42	44
TRUE CONC (C), UG/L	71.00	78.00	71.00	78.00
MEAN RECOVERY ($\overline{X}$)	69.98	73.70	68.69	76.00
RECOVERY (%)	98.54	94.49	96.75	97.44
OVERALL STD DEV (S)	13.04	11.93	7.92	11.45
OVERALL REL STD DEV, %	18.64	16.18	11.53	15.06
SINGLE STD DEV, (S_r)	9.50		5.54	
ANALYST REL DEV, %	13.23		7.66	

USEPA METHOD STUDY ~~7, TRACE METALS~~

TABLE 56: STATISTICAL SUMMARY

LOW LEVEL ANALYSES FOR CADMIUM

BY DIRECT ASPIRATION

		DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR		5	6	5	6
NUMBER OF DATA POINTS		16	18	12	16
TRUE CONC (C), UG/L		1.40	2.80	1.40	2.80
MEAN RECOVERY ($\overline{X}$)		4.36	3.51	2.42	4.57
RECOVERY (%)		311.61	125.20	173.21	163.17
OVERALL STD DEV (S)		4.22	2.47	1.78	3.45
OVERALL REL STD DEV, %		96.75	70.38	73.43	75.79
SINGLE	STD DEV, (S_r)	2.51		1.23	
ANALYST	REL DEV, %	63.88		35.17	

AFTER EXTRACTION

		DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR		5	6	5	6
NUMBER OF DATA POINTS		35	36	32	32
TRUE CONC (C), UG/L		1.40	2.80	1.40	2.80
MEAN RECOVERY ($\overline{X}$)		1.87	2.72	1.74	2.82
RECOVERY (%)		133.49	96.98	124.06	100.79
OVERALL STD DEV (S)		1.13	1.21	1.17	1.22
OVERALL REL STD DEV, %		60.35	44.41	67.20	43.29
SINGLE	STD DEV, (S_r)	0.68		0.70	
ANALYST	REL DEV, %	29.48		30.60	

AFTER CONCENTRATION

		DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR		5	6	5	6
NUMBER OF DATA POINTS		6	9	7	9
TRUE CONC (C), UG/L		1.40	2.80	1.40	2.80
MEAN RECOVERY ($\overline{X}$)		1.37	2.72	2.62	3.13
RECOVERY (%)		97.96	97.22	186.90	111.90
OVERALL STD DEV (S)		0.44	0.66	1.49	1.62
OVERALL REL STD DEV, %		32.26	24.07	57.12	51.58
SINGLE	STD DEV, (S_r)	0.66		1.03	
ANALYST	REL DEV, %	32.45		35.89	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 57: STATISTICAL SUMMARY

CHROMIUM ANALYSES BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	27	39	26	28
TRUE CONC (C), UG/L	7.40	15.00	7.40	15.00
MEAN RECOVERY ($\overline{X}$)	16.48	30.49	12.90	20.89
RECOVERY (%)	222.67	203.25	174.32	139.29
OVERALL STD DEV (S)	12.35	26.51	7.69	8.01
OVERALL REL STD DEV, %	74.97	86.94	59.58	38.32
SINGLE STD DEV, (S_r)	11.35		4.23	
ANALYST REL DEV, %	48.32		25.05	
MEDIUM YOUDEN PAIR	2	3	2	3
NUMBER OF DATA POINTS	43	42	43	41
TRUE CONC (C), UG/L	74.00	93.00	74.00	93.00
MEAN RECOVERY ($\overline{X}$)	76.58	94.12	74.23	90.76
RECOVERY (%)	103.49	101.20	100.31	97.59
OVERALL STD DEV (S)	14.80	15.82	19.90	18.68
OVERALL REL STD DEV, %	19.33	16.81	26.81	20.58
SINGLE STD DEV, (S_r)	7.42		10.80	
ANALYST REL DEV, %	8.70		13.09	
HIGH YOUDEN PAIR	1	4	1	4
NUMBER OF DATA POINTS	43	42	42	42
TRUE CONC (C), UG/L	370.00	407.00	370.00	407.00
MEAN RECOVERY ($\overline{X}$)	362.26	405.21	361.10	401.57
RECOVERY (%)	97.91	99.56	97.59	98.67
OVERALL STD DEV (S)	54.67	55.20	54.08	56.29
OVERALL REL STD DEV, %	15.09	13.62	14.98	14.02
SINGLE STD DEV, (S_r)	22.84		21.62	
ANALYST REL DEV, %	5.95		5.67	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 58: STATISTICAL SUMMARY

LOW LEVEL ANALYSES FOR CHROMIUM

BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	27	39	26	28
TRUE CONC (C), UG/L	7.40	15.00	7.40	15.00
MEAN RECOVERY ($\overline{X}$)	16.48	30.49	12.90	20.89
RECOVERY (%)	222.67	203.25	174.32	139.29
OVERALL STD DEV (S)	12.35	26.51	7.69	8.01
OVERALL REL STD DEV, %	74.97	86.94	59.58	38.32
SINGLE STD DEV, (S_r)	11.35		4.23	
ANALYST REL DEV, %	48.32		25.05	

AFTER EXTRACTION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	20	23	21	23
TRUE CONC (C), UG/L	7.40	15.00	7.40	15.00
MEAN RECOVERY ($\overline{X}$)	6.83	13.34	9.14	14.77
RECOVERY (%)	92.30	89.93	123.49	98.43
OVERALL STD DEV (S)	2.24	3.96	5.42	4.96
OVERALL REL STD DEV, %	32.86	29.69	59.37	33.58
SINGLE STD DEV, (S_r)	2.01		4.11	
ANALYST REL DEV, %	19.94		34.41	

AFTER CONCENTRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	12	11	10	10
TRUE CONC (C), UG/L	7.40	15.00	7.40	15.00
MEAN RECOVERY ($\overline{X}$)	8.67	15.45	8.20	13.50
RECOVERY (%)	117.12	103.03	110.81	90.00
OVERALL STD DEV (S(	1.44	2.07	1.99	3.17
OVERALL REL STD DEV, %	16.56	13.38	24.25	23.49
SINGLE STD DEV, (S_r)	1.46		2.45	
ANALYST REL DEV, %	12.14		22.59	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 59: STATISTICAL SUMMARY

COPPER ANALYSES BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	41	44	32	31
TRUE CONC (C), UG/L	7.50	12.00	7.50	12.00
MEAN RECOVERY ($\overline{X}$)	15.50	22.95	14.32	19.26
RECOVERY (%)	206.70	191.27	190.87	160.54
OVERALL STD DEV (S)	11.70	16.92	12.65	12.92
OVERALL REL STD DEV, %	75.49	73.73	88.35	67.08
SINGLE STD DEV, (S_r)	5.85		4.41	
ANALYST REL DEV, %	30.45		26.25	
MEDIUM YOUDEN PAIR	2	3	2	3
NUMBER OF DATA POINTS	43	43	44	44
TRUE CONC (C), UG/L	60.00	75.00	60.00	75.00
MEAN RECOVERY ($\overline{X}$)	62.16	74.00	58.57	70.98
RECOVERY (%)	103.60	98.67	97.61	94.64
OVERALL STD DEV (S)	17.48	12.46	13.82	13.38
OVERALL REL STD DEV, %	28.12	16.84	23.59	18.85
SINGLE STD DEV, (S_r)	7.47		6.78	
ANALYST REL DEV, %	10.98		10.47	
HIGH YOUDEN PAIRR	1	4	1	4
NUMBER OF DATA POINTS	43	43	43	44
TRUE CONC (C), UG/L	302.00	332.00	302.00	332.00
MEAN RECOVERY ($\overline{X}$)	297.60	320.60	289.23	308.39
RECOVERY (%)	98.54	94.57	95.77	92.89
OVERALL STD DEV (S)	26.86	29.91	30.23	38.54
OVERALL REL STD DEV, %	9.03	9.33	10.45	12.50
SINGLE STD DEV, (S_r)	17.63		12.01	
ANALYST REL DEV, %	5.70		4.02	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 60: STATISTICAL SUMMARY

LOW LEVEL ANALYSES FOR COPPER

BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	41	44	32	31
TRUE CONC (C), UG/L	7.50	12.00	7.50	12.00
MEAN RECOVERY ($\overline{X}$)	15.50	22.95	14.32	19.26
RECOVERY (%)	206.70	191.27	190.87	160.54
OVERALL STD DEV (S)	11.70	16.92	12.65	12.92
OVERALL REL STD DEV, %	75.49	73.73	88.35	67.08
SINGLE STD DEV, (S_r)	5.85		4.41	
ANALYST REL DEV, %	30.45		26.25	

AFTER EXTRACTION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	35	37	35	35
TRUE CONC (C), UG/L	7.50	12.00	7.50	12.00
MEAN RECOVERY ($\overline{X}$)	9.11	13.09	9.45	11.59
RECOVERY (%)	121.41	109.08	125.94	96.60
OVERALL STD DEV (S)	4.73	7.14	4.21	5.52
OVERALL REL STD DEV, %	51.96	54.58	44.58	47.65
SINGLE STD DEV, (S_r)	2.11		1.91	
ANALYST REL DEV, %	19.02		18.13	

AFTER CONCENTRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	12	12	9	10
TRUE CONC (C), UG/L	7.50	12.00	7.50	12.00
MEAN RECOVERY ($\overline{X}$)	11.15	14.67	6.90	10.60
RECOVERY (%)	148.67	122.22	92.00	88.33
OVERALL STD DEV (S)	5.25	4.87	1.97	3.27
OVERALL REL STD DEV, %	47.07	33.19	28.58	30.88
SINGLE STD DEV, (S_r)	1.38		1.29	
ANALYST REL DEV, %	10.72		14.76	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 61: STATISTICAL SUMMARY

IRON ANALYSES BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	38	35	33	32
TRUE CONC (C), UG/L	24.00	10.00	24.00	10.00
MEAN RECOVERY $(\bar{X})$	57.42	50.42	67.27	124.06
RECOVERY (%)	239.27	504.20	280.30	1240.63
OVERALL STD DEV (S)	45.50	57.72	58.51	170.69
OVERALL REL STD DEV, %	79.24	114.48	86.97	137.59
SINGLE STD DEV, (S_r)	11.85		17.85	
ANALYST REL DEV, %	21.98		18.66	
MEDIUM YOUDEN PAIR	2	3	2	3
NUMBER OF DATA POINTS	43	43	43	42
TRUE CONC (C), UG/L	350.00	438.00	350.00	438.00
MEAN RECOVERY $(\bar{X})$	348.67	433.88	375.21	464.95
RECOVERY (%)	99.62	99.06	107.20	106.15
OVERALL STD DEV (S)	52.75	43.11	85.92	89.78
OVERALL REL STD DEV, %	15.13	9.94	22.90	19.31
SINGLE STD DEV, (S_r)	28.53		59.43	
ANALYST REL DEV, %	7.29		14.15	
HIGH YOUDEN PAIR	1	4	1	4
NUMBER OF DATA POINTS	45	44	41	42
TRUE CONC (C), UG/L	840.00	700.00	840.00	700.00
MEAN RECOVERY $(\bar{X})$	842.82	692.77	854.61	698.90
RECOVERY (%)	100.34	98.97	101.74	99.84
OVERALL STD DEV (S)	69.07	50.81	78.27	81.94
OVERALL REL STD DEV, %	8.19	7.33	9.16	11.72
SINGLE STD DEV, (S_r)	35.57		55.42	
ANALYST REL DEV, %	4.63		7.14	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 62: STATISTICAL SUMMARY

LOW LEVEL ANALYSES FOR IRON

BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	38	35	33	32
TRUE CONC (C), UG/L	24.00	10.00	24.00	10.00
MEAN RECOVERY ($\bar{X}$)	57.42	50.42	67.27	124.06
RECOVERY (%)	239.27	504.20	280.30	1240.63
OVERALL STD DEV (S)	45.50	57.72	58.51	170.69
OVERALL REL STD DEV, %	79.24	114.48	86.97	137.59
SINGLE STD DEV, (S_r)	11.85		17.85	
ANALYST REL DEV, %	21.98		18.66	

AFTER EXTRACTION

LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	31	33	24	23
TRUE CONC (C), UG/L	24.00	10.00	24.00	10.00
MEAN RECOVERY ($\bar{X}$)	30.56	21.88	39.97	37.13
RECOVERY (%)	127.33	218.82	166.55	371.30
OVERALL STD DEV (S)	13.32	14.85	28.08	29.65
OVERALL REL STD DEV, %	43.58	67.86	70.25	79.86
SINGLE STD DEV, (S_r)	8.04		15.34	
ANALYST REL DEV, %	30.67		39.79	

AFTER CONCENTRATION

LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	10	10	6	5
TRUE CONC (C), UG/L	24.00	10.00	24.00	10.00
MEAN RECOVERY ($\bar{X}$)	37.80	22.60	22.83	15.12
RECOVERY (%)	157.50	226.00	95.14	151.20
OVERALL STD DEV (S)	15.64	11.98	10.98	5.46
OVERALL REL STD DEV, %	41.38	53.02	48.09	36.09
SINGLE STD DEV, (S_r)	4.65		6.71	
ANALYST REL DEV, %	15.41		35.37	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 63: STATISTICAL SUMMARY

LEAD ANALYSES BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	25	24	27	25
TRUE CONC (C), UG/L	37.00	25.00	37.00	25.00
MEAN RECOVERY ($\overline{X}$)	52.64	40.35	75.37	49.92
RECOVERY (%)	142.27	61.42	103.70	99.68
OVERALL STD DEV (S)	36.76	36.38	67.27	36.09
OVERALL REL STD DEV, %	69.84	90.15	89.25	72.29
SINGLE STD DEV, (S_r)	13.05		31.44	
ANALYST REL DEV, %	28.06		50.19	
MEDIUM YOUDEN PAIR	2	3	2	3
NUMBER OF DATA POINTS	43	40	38	38
TRUE CONC (C), UG/L	101.00	84.00	101.00	84.00
MEAN RECOVERY ($\overline{X}$)	107.70	96.72	105.66	100.03
RECOVERY (%)	106.63	115.15	104.61	119.08
OVERALL STD DEV (S)	37.69	36.00	29.54	35.44
OVERALL REL STD DEV, %	34.99	37.22	27.96	35.43
SINGLE STD DEV, (S_r)	17.15		17.94	
ANALYST REL DEV, %	16.78		17.45	
HIGH YOUDEN PAIRR	1	4	1	4
NUMBER OF DATA POINTS	41	38	40	39
TRUE CONC (C), UG/L	367.00	334.00	367.00	334.00
MEAN RECOVERY ($\overline{X}$)	374.85	329.68	378.07	347.49
RECOVERY (%)	102.14	98.71	103.02	104.04
OVERALL STD DEV (S)	46.81	40.54	68.64	75.68
OVERALL REL STD DEV, %	12.49	12.30	18.15	21.78
SINGLE STD DEV, (S_r)	19.78		48.32	
ANALYST REL DEV, %	5.62		13.32	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 64: STATISTICAL SUMMARY

LOW LEVEL ANALYSES FOR LEAD

BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	25	24	27	25
TRUE CONC (C), UG/L	37.00	25.00	37.00	25.00
MEAN RECOVERY ($\bar{X}$)	52.64	40.35	75.37	49.92
RECOVERY (%)	142.27	61.42	103.70	99.68
OVERALL STD DEV (S)	36.76	36.38	67.27	36.09
OVERALL REL STD DEV, %	69.84	90.15	89.25	72.29
SINGLE STD DEV, (S_r)	13.05		31.44	
ANALYST REL DEV, %	28.06		50.19	

AFTER EXTRACTION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	44	45	41	43
TRUE CONC (C), UG/L	37.00	25.00	37.00	25.00
MEAN RECOVERY ($\bar{X}$)	35.66	25.14	37.76	25.58
RECOVERY (%)	96.37	100.55	102.04	102.31
OVERALL STD DEV (S)	17.11	11.82	17.14	14.14
OVERALL REL STD DEV, %	47.99	47.04	45.39	55.29
SINGLE STD DEV, (S_r)	7.53		7.52	
ANALYST REL DEV, %	24.77		23.76	

AFTER CONCENTRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	11	11	11	11
TRUE CONC (C), UG/L	37.00	25.00	37.00	25.00
MEAN RECOVERY ($\bar{X}$)	40.73	27.82	42.91	31.00
RECOVERY (%)	110.07	111.27	115.97	124.00
OVERALL STD DEV (S)	10.32	9.66	19.36	19.09
OVERALL REL STD DEV, %	25.33	34.73	45.11	61.60
SINGLE STD DEV, (S_r)	2.50		3.93	
ANALYST REL DEV, %	7.29		10.63	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 65: STATISTICAL SUMMARY

MANGANESE ANALYSES BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	43	46	37	40
TRUE CONC (C), UG/L	11.00	17.00	11.00	17.00
MEAN RECOVERY ($\bar{X}$)	21.58	18.65	13.34	20.25
RECOVERY (%)	196.22	109.69	121.30	119.12
OVERALL STD DEV (S)	20.65	7.68	7.42	10.57
OVERALL REL STD DEV, %	95.67	41.19	55.64	52.20
SINGLE STD DEV, (S_r)	9.03		4.70	
ANALYST REL DEV, %	44.87		27.96	
MEDIUM YOUDEN PAIR	2	3	2	3
NUMBER OF DATA POINTS	42	42	44	43
TRUE CONC (C), UG/L	84.00	106.00	84.00	106.00
MEAN RECOVERY ($\bar{X}$)	82.05	102.67	87.41	106.84
RECOVERY (%)	97.68	96.86	104.06	100.79
OVERALL STD DEV (S)	11.19	15.27	14.97	15.54
OVERALL REL STD DEV, %	13.64	14.87	17.12	14.54
SINGLE STD DEV, (S_r)	7.05		6.14	
ANALYST REL DEV, %	7.63		6.32	
HIGH YOUDEN PAIRR	1	4	1	4
NUMBER OF DATA POINTS	43	42	45	45
TRUE CONC (C), UG/L	426.00	469.00	426.00	469.00
MEAN RECOVERY ($\bar{X}$)	418.95	462.69	425.53	462.64
RECOVERY (%)	98.35	98.65	99.89	98.64
OVERALL STD DEV (S)	22.69	30.25	27.42	38.74
OVERALL REL STD DEV, %	5.42	6.54	6.44	8.37
SINGLE STD DEV, (S_r)	15.15		15.24	
ANALYST REL DEV, %	3.44		3.43	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 66: STATISTICAL SUMMARY

LOW LEVEL ANALYSES FOR MANGANESE

BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	43	46	37	40
TRUE CONC (C), UG/L	11.00	17.00	11.00	17.00
MEAN RECOVERY ($\overline{X}$)	21.58	18.65	13.34	20.25
RECOVERY (%)	196.22	109.69	121.30	119.12
OVERALL STD DEV (S)	20.65	7.68	7.42	10.57
OVERALL REL STD DEV, %	95.67	41.19	55.64	52.20
SINGLE STD DEV, (S_r)	9.03		4.70	
ANALYST REL DEV, %	44.87		27.96	

AFTER EXTRACTION

LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	12	12	12	12
TRUE CONC (C), UG/L	11.00	17.00	11.00	17.00
MEAN RECOVERY ($\overline{X}$)	25.01	15.52	22.83	27.25
RECOVERY (%)	227.35	91.32	207.58	160.29
OVERALL STD DEV (S)	29.29	6.99	22.75	22.26
OVERALL REL STD DEV, %	117.11	45.03	99.62	81.67
SINGLE STD DEV, (S_r)	2.99		3.47	
ANALYST REL DEV, %	14.78		13.86	

AFTER CONCENTRATION

LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	12	12	9	10
TRUE CONC (C), UG/L	11.00	17.00	11.00	17.00
MEAN RECOVERY ($\overline{X}$)	11.00	16.42	8.33	14.10
RECOVERY (%)	100.00	96.57	75.76	82.94
OVERALL STD DEV (S)	1.13	1.68	2.65	4.53
OVERALL REL STD DEV, %	10.26	10.21	31.75	32.15
SINGLE STD DEV, (S_r)	0.80		1.83	
ANALYST REL DEV, %	5.82		16.31	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 67: STATISTICAL SUMMARY

SELENIUM ANALYSES BY COLORIMETRY

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	14	12	9	9
TRUE CONC (C), UG/L	4.70	7.80	4.70	7.80
MEAN RECOVERY ($\overline{X}$)	3.93	7.22	3.80	5.81
RECOVERY (%)	83.59	92.52	80.85	74.50
OVERALL STD DEV (S)	1.20	1.31	1.21	2.23
OVERALL REL STD DEV, %	30.44	18.14	31.96	38.42
SINGLE STD DEV, (S_r)	0.69		2.16	
ANALYST REL DEV, %	12.30		44.99	
MEDIUM YOUDEN PAIR	2	3	2	3
NUMBER OF DATA POINTS	14	13	11	11
TRUE CONC (C), UG/L	12.00	19.00	12.00	19.00
MEAN RECOVERY ($\overline{X}$)	9.21	12.56	8.93	11.35
RECOVERY (%)	76.79	66.11	74.39	59.76
OVERALL STD DEV (S)	3.24	6.26	4.04	7.26
OVERALL REL STD DEV, %	35.18	49.85	45.23	63.98
SINGLE STD DEV, (S_r)	2.90		3.59	
ANALYST REL DEV, %	26.59		35.37	
HIGH YOUDEN PAIR	1	4	1	4
NUMBER OF DATA POINTS	14	14	10	12
TRUE CONC (C), UG/L	43.00	49.00	43.00	49.00
MEAN RECOVERY ($\overline{X}$)	28.46	31.69	26.50	29.02
RECOVERY (%)	66.20	64.66	61.63	59.22
OVERALL STD DEV (S)	11.29	12.85	13.89	16.24
OVERALL REL STD DEV, %	39.66	40.54	52.42	55.97
SINGLE STD DEV, (S_r)	3.96		10.18	
ANALYST REL DEV, %	13.18		36.69	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 68: STATISTICAL SUMMARY

ZINC ANALYSES BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	43	44	43	44
TRUE CONC (C), UG/L	7.00	11.00	7.00	11.00
MEAN RECOVERY ($\overline{X}$)	16.44	20.03	17.66	24.18
RECOVERY (%)	234.92	182.07	252.33	219.84
OVERALL STD DEV (S)	14.40	16.30	17.12	24.74
OVERALL REL STD DEV, %	87.55	81.39	96.94	102.32
SINGLE STD DEV, (S_r)	6.79		8.48	
ANALYST REL DEV, %	37.23		40.54	
MEDIUM YOUDEN PAIR	2	3	2	3
NUMBER OF DATA POINTS	42	41	41	44
TRUE CONC (C), UG/L	56.00	70.00	56.00	70.00
MEAN RECOVERY ($\overline{X}$)	55.88	70.98	57.07	70.82
RECOVERY (%)	99.79	101.39	101.92	101.17
OVERALL STD DEV (S)	16.18	14.56	14.77	19.40
OVERALL REL STD DEV, %	28.96	20.51	25.89	27.39
SINGLE STD DEV, (S_r)	4.21		7.02	
ANALYST REL DEV, %	6.64		10.97	
HIGH YOUDEN PAIR	1	4	1	4
NUMBER OF DATA POINTS	45	44	42	42
TRUE CONC (C), UG/L	281.00	310.00	281.00	310.00
MEAN RECOVERY ($\overline{X}$)	282.82	307.66	279.50	309.50
RECOVERY (%)	100.65	99.24	99.47	99.84
OVERALL STD DEV (S)	32.50	37.26	27.88	34.34
OVERALL REL STD DEV, %	11.49	12.11	9.97	11.09
SINGLE STD DEV, (S_r)	15.59		15.18	
ANALYST REL DEV, %	5.28		5.15	

USEPA METHOD STUDY 7, TRACE METALS

TABLE 69: STATISTICAL SUMMARY

LOW LEVEL ANALYSES FOR ZINC

BY DIRECT ASPIRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	43	44	43	44
TRUE CONC (C), UG/L	7.00	11.00	7.00	11.00
MEAN RECOVERY ($\overline{X}$)	16.44	20.03	17.66	24.18
RECOVERY (%)	234.92	182.07	252.33	219.84
OVERALL STD DEV (S)	14.40	16.30	17.12	24.74
OVERALL REL STD DEV, %	87.55	81.39	96.94	102.32
SINGLE STD DEV, (S_r)	6.79		8.48	
ANALYST REL DEV, %	37.23		40.54	

AFTER EXTRACTION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	20	17	17	13
TRUE CONC (C), UG/L	7.00	11.00	7.00	11.00
MEAN RECOVERY ($\overline{X}$)	14.43	10.86	19.84	10.81
RECOVERY (%)	206.21	98.70	283.45	98.25
OVERALL STD DEV (S)	17.08	5.72	21.55	5.47
OVERALL REL STD DEV, %	118.32	52.69	108.63	50.61
SINGLE STD DEV, (S_r)	2.70		8.54	
ANALYST REL DEV, %	21.32		55.70	

AFTER CONCENTRATION

	DISTILLED WATER		NATURAL WATER	
LOW YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	12	11	6	8
TRUE CONC (C), UG/L	7.00	11.00	7.00	11.00
MEAN RECOVERY ($\overline{X}$)	14.43	18.64	8.83	13.25
RECOVERY (%)	204.88	169.42	126.19	120.45
OVERALL STD DEV (S)	8.58	10.22	3.92	5.97
OVERALL REL STD DEV, %	59.81	54.84	44.38	45.06
SINGLE STD DEV, (S_r)	3.02		2.03	
ANALYST REL DEV, %	18.33		18.41	